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A MONOGRAPH OF THE

PLECOPTERA

OR

STONEFLIES

OF AMERICA NORTH OF MEXICO

By
J. G. NEEDHAM and P. W. CLAASSEN

LaFayette, Indiana
1925

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INTRODUCTION.

It is pleasant to find that the beginning of our knowledge of North American stoneflies was made by the "Father of American Entomology," Thomas Say. In 1823 he described four species in *Godman's Western Quarterly Reporter,* and described them so well that, although the types were long since lost, we have been able to recognize them all. The scattered descriptions that followed during the next four decades were mostly written by European entomologists —by Newman and Newport and Walker in England, by Pictet and Rambur in France, and by Burmeister in Germany. The first comprehensive review of the American fauna was that of Hagen, included in his *Synopsis of the Neuroptera of North America* (1861). Hagen recognized 61 nominal species in North America, disposed in seven genera, 40 of the species being retained in the original genus Perla. This work was prepared in Koenigsberg, at the special request of the Smithsonian Institution, from materials supplied by that institution and by collaborators. Its publication incited Benjamin D. Walsh, who then lived in Rock Island, Ill., to collect and study the Neuropteroids of his own vicinity. The following year (1862) he published a list of the species in his own collection with descriptions of a number of new species. He collected so assiduously that the vicinity of Rock Island, Ill., has remained until recently one of the best worked fields in America for the Neuropteroid groups. Since Walsh's time, the one persistent student of the group in America has been Mr. Nathan Banks. In a long series of papers he has described many new forms, and he has twice catalogued the American species (1892 and 1907).

More recently there have been noteworthy contributions to the knowledge of the group in America by Dr. Lucy Wright Smith (now Mrs. Wilbert A. Clemens) and by Mr. C. F. Wu. Mr. Wu's work

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on Nemoura is so fine a monograph on the structure and behavior of a very primitive winged insect that it might well serve as a text-book for an introductory course in entomology. Miss Smith did comparable though less extensive work on one of Say's original species, *Perla immarginata;* and then began a systematic treatment of the order, of which this present monograph is a continuation. We have done little more with that portion of the group which she studied (the Pteronarcidae) than to adopt and incorporate her results.

In the course of the years during which materials have been gathered for this monograph, we have been aided in various ways by so many helpfully minded people that it is now impossible for us to mention them all by name, though we wish to acknowledge our obligation to all. We are especially indebted for the loan of specimens to the following museums: The Museum of Comparative Zoology of Harvard University, the U. S. National Museum, the Boston Society of Natural History, the Provincial Museum of Quebec, the California Academy of Sciences, the American Museum of Natural History; also to the entomological collections of Stanford University, of the Universities of Illinois, Kansas, and Michigan, and of the State Agricultural Colleges of Kansas, Oregon, Utah, Montana, and North Carolina.

Specimens have been received from the following individuals: C. P. Alexander, Nathan Banks, C. Betten, C. S. Brimley, C. R. Crosby, P. P. Calvert, R. A. Cooley, J. C. Bradley, W. J. Chamberlain, Norman Criddle, A. N. Caudell, T. D. A. Cockerell, P. J. Chapman, William T. Davis, George A. Dean, G. S. Dodds, S. A. Forbes, C. A. Frost, C. P. Gillette, I. M. Hawley, W. E. Hoffman, S. J. Hunter, W. E. Howard, Mrs. W. W. Hippisley, C. W. Johnson, Trevor Kincaid, A. L. Lovett, J. McDunnough, A. E. Miller, Miss G. Myers, R. Matheson, R. A. Muttkowski, P. B. Powell, S. A. Rohwer, R.

C. Smith, C. K. Sibley, E. C. VanDyke, E. P. VanDuzee, R. J. Weith.

In working over the materials and in the preparation of drawings we have been aided by many of our advanced students, especially the following: Miss Hazel E. Branch, Miss Ellen Edmonson, Miss Mary J. Fisher, Mrs. Quinta Cattell Kessel, Miss Leola J. Kruger, Miss Theresa McConnell, Miss Theresa M. Robinson, Mr. C. F. Wu, also by Mr. Albert Force and Mr. C. H. Curran. Very special courtesies have been shown us in the way of museum privileges by Abbe Huard of the Provincial Museum Quebec; by Mr. Samuel Henshaw of the Museum of Comparative Zoology; by Dr. Walther Horn of the Berlin Museum, in the loan for study of Burmeister's types and by Dr. Nathan Banks in the loan of manuscript notes on types in the British Museum. Our figures of the species of Pteronarcys are copied from the plates of Lucy Wright Smith. Much assistance has been given by Mrs. V. N. Argo in the reading of the proofs.

BIOLOGY.

Stoneflies in their immature stage are all inhabitants of running water, and so are to be sought as adults in the vicinity of streams. There is hardly a better way of obtaining the smaller and less active species than the old-fashioned entomologists' method of beating the bushes over an inverted umbrella, or sweeping the streamside vegetation with a heavy beating net. Many of the larger Perlidae are attracted to lights at night and may be sought about the street lamps near streams. The senior author once found the stout-bodied stonefly *Acroneuria pacifica*, clinging in numbers to young pine trees on the steep slopes of the Yellowstone Canyon, and obtained specimens very easily by shaking the trees, dashing the stoneflies to the ground, and picking them up before they had run to cover.

Only a few forms, mostly the greenish ones, are active by day, and run about over foliage. For the most part they do not take flight quickly, but many of them run rapidly and slip into hiding places most adroitly. Adult stoneflies may be collected even in northern latitudes every month in the year. The small black Capniidae are the winter forms. These are usually seen on warm days in winter on fresh banks of snow, where their color makes them conspicuous. A number of dusky-winged Nemouridae next follow in early spring. The big Pteronarcidae come next, and the Perlidae fill out the season. Most characteristic of midsummer are the greenish, diurnal foliage-inhabiting stoneflies of the genera Isoperla, Alloperla, and Chloroperla.

The immature stage (larva, nymph or naiad) resembles, in general, the adult, but the wings are lacking and they always occur in water, either under stones or under drifted leaves, debris, etc. The mouthparts are of the biting type and are well developed. As far as we know, all nymphs possess long filamentous, many-segmented cerci. Tracheal gills are present in most genera and are mostly of the filamentous type. The gills may occur in tufts, or as single filaments and are placed on the sides of the thorax, on the sides and tip of the abdomen or in the cervical region. In Taeniopteryx they consist of three-segmented filaments attached to the coxae. The gills persist in some of the adults, but are non-functional.

Comparatively little work has been done on the biology of stoneflies. At least one year seems to be required

to complete the life cycle, and in some of the larger species two or even three years may be consumed.

The complete life history of a small species, *Nemoura vallicularia* Wu, has recently been published.* This species passes through 22 developmental instars and completes a generation in one year. It is entirely herbivorous, feeding upon dead vegetable matter. Heretofore stoneflies have usually been considered as carnivorous, but the examination of stomach contents of a number of nymphs indicate that Pteronarcys, Nemoura and others feed upon vegetable matter only, while Perla, Acroneuria, etc., prey upon animal forms as well as feeding upon vegetable material.

Most stoneflies do not feed in the adult stage, but some species have well developed mouthparts and one species *Taeniopteryx pacifica* Banks—(*Taeniopema analis* Banks) has been recorded as injuring the buds of fruit trees on the Pacific Coast.

COLLECTING AND PRESERVING.

Specimens for study are best preserved in alcohol (70 to 80 per cent strength). They may be pinned and spread and dried and kept in boxes, as are most other insects, and the general collector of insects will probably prefer to keep them so; but their colors fade quickly and they shrivel like prunes in drying, and they form a very unattractive part of a pinned collection of insects. Our method is to preserve fresh material at once in alcohol in homeopathic vials, hanging the vials to a handy wire rack by a small hanger attached to the neck of each vial: the vials thus hang vertically, and good corks, having no alcohol in contact with them, last a long time. We mount detached wings for study outspread upon a glass slide under a cover glass that is held by a strip of gummed paper over each end, binding slide and cover glass together. All the wing figures of this volume were made from such mounts. We mount the wings dry, not in balsam, which having the same refraction as the weaker veins, render some of them invisible.

For the study of the genitalia we snip off the abdomen, boil it for a few minutes in caustic potash until the flesh has been removed and only chitin remains and then keep this boiled portion in the vial with the unboiled part of the specimen. We do not mount it in balsam because it

*Wu, C. F. Morphology, Anatomy and Ethology of Nemoura—Bulletin 23, Entomological Series No. 3, Bulletin of the Lloyd Library, 1923.

must be free to be turned in any position for study. Only the color is lost in boiling. In some of the genera the critical determination of the species is scarcely possible without this treatment, which loosens up the connectives between the segments so that hidden, retractile parts may be exposed.

DIAGNOSTIC CHARACTERS.

Stoneflies are the most primitive of winged insects. Metamorphosis is very slight, even nymphal gills in several genera being carried over into adult life. There is little of that specialization which in the higher insects fixes color patterns and the finer details of structure along sharply defined specific lines. All characters of coloration, venation, size and form vary enormously. Even secondary sexual characters, the ultimate criteria of species here as in other groups, are relatively inconstant. The form of the subgenital plate of the female has been much used to distinguish American species and a most useful character it is; but it should be used with discretion, for it is subject to malformation and to shrinkage and distortion on drying, and is altered somewhat with the age of the specimens. A critical study of the numerous species that have been based on variants of color patterns and variants of form of subgenital plate, has led us to the suppression of a good many names as synonyms, including some of our own. He who, familiar with the relative fixity of small characters in the higher orders, turns to the study of the Plecoptera, will soon learn that he is dealing with differences of another order and of wider latitude.

In the following pages we propose to give a brief review of those characters that have proved most useful in the systematic study of this order of insects; also, to point out certain limitations in the use of these characters.

Stoneflies are soft-bodied insects less constant in structural details, as already stated, than are the higher orders. Most readily observable and least distorted in drying are the wing venation and the proportionate length of the tarsal segments, and these will serve for recognition of the larger groups, while here, as elsewhere, the ultimate criteria for species are found in genitalia.

The head is broad and flattened, widest across the eyes, that are set far forward in Kathroperla (Pl. 1, fig. 11) and well to rearward in Acroneuria (Pl. 1, figs. 1, 2, 3, 5 and

8). There is a free antennal sclerite in Pteronarcys, the angulation of whose upper border varies with groups of species. There are raised marks upon the frons of two very different sorts, the foremost being a transverse elevated frontal ridge that usually takes the form of a letter M. The median ocellus stands at the middle point of the M and sometimes interrupts it. When the outer limbs of the M disappear the middle portion often remains as a U or a V. Lateral to the ocellar triangle there is a pair of tubercles upon the frons. These are generally oval or round, but may be crescentic, linear or obsolete. The eyes are of moderate size in all stoneflies but the ocelli are very variable. The median ocellus is smaller than the laterals in a number of genera and is entirely wanting in Neoperla and Peltoperla. The ocelli are smallest and widest apart in Isogenus, and largest and closest together in *Perla venosa*.

The antennae are long and slowly tapering from the two stout basal segments of the pedicel; the second segment is always slenderer than the first, and varies from being nearly as long in Kathroperla to being only about an eighth as long in Pteronarcys. The remaining segments are very numerous, cylindric, slowly increasing in length outward from the base of the flagellum and in the Isoperla allies and in Taeniopteryx becoming at the tip twice as long as is the stout basal segment. The total number of segments comprising the antennae is very large, numbering between 95 and 100 in the larger species of Acroneuria, about 60 in Peltoperla and Pteronarcys, about 40 in Leuctra and about 25 in Capnella.

The mouth parts are of the primitive biting type. The mandibles are reduced to thin and rather weak rudiments in the family Perlidae (Pl. 3, fig. 3) though normally chitinized and functional in the other families (Pl. 3, fig. 7): The only parts that are used for systematic purposes are the maxillary and labial palpi.

The maxillary palpi are 5-jointed, cylindric, and rather long. The three terminal segments are similar in length and thickness in three families, but in Perlidae the terminal segments become progressively reduced, the last segment reaching its minimum development in Alloperla, where it is hardly more than a rudiment. The terminal segment of the labial palpi is relatively less reduced in Alloperla, but is generally smaller than the preceding segment throughout the order.

The prothorax is generally quadrangular, in only a few

species (Pteronarcys) is it widened to rearward. It is transversely oval in Kathroperla, Paraperla, Alloperla and Chloroperla, and is strongly narrowed behind and often broadly rounded at the rear in Perla. The rugosities upon the sides of the disc are often polished embossed markings, arranged in patterns more or less indefinite but often roughly characteristic of groups.

The legs are strong, with laterally flattened femora (toothed in *Taeniopteryx maura*), and the tarsi are three jointed and bear stout terminal claws. The relative length of the three tarsal segments has long been successfully used to distinguish the principal groups. These are of nearly equal length in Taeniopteryx only. The middle one alone becomes greatly reduced in length in the remaining Nemouridae and in the Capnidae. The two basal segments become reduced together (the basal one more slowly) in Pteronarcys and Perlidae, extreme and equal reduction occurring in the genus Alloperla.

The legs increase in length from front to rear, the hind ones becoming relatively longest in Pteronarcella. Femur and tibia are of equal length in Acroneuria but the tibia becomes a fourth the longer in Peltoperla. Tibial spurs are strongly developed in Nemoura and Taeniopteryx, but become rudimentary in Acroneuria. The claws, always well developed, are relatively shortest in Pteronarcella and longest in Acroneuria, and they are armed beneath with a spinelike tooth in Peltoperla.

Venation.

The veins of the wings of stoneflies are those indicated in the accompanying explanatory diagram. In the more generalized Pteronarcidae crossveins are numerous and tend to be distributed generally over the surface of the wing, but in the higher and more typical Plecoptera, the number of crossveins is reduced, those remaining being the same ones present in other large orders of insects (the crossveins that bear individual names in the figure) together with two series of less regular and less constant crossveins that extend outward from the wing base, one in the costal space in linear series, and one in the median and cubital crossveins, a double line in parallel series. This last series appears to be peculiar to the order Plecoptera. So also is the basal fusion of veins Rs and M in the hind wing.

There are two lines of transverse bracing across the wing. These are both formed in part from principal

crossveins and in part from angulated portions of longitudinal veins. The basal one comprises the humeral crossvein at the front, the arculus and cubito-anal cross-

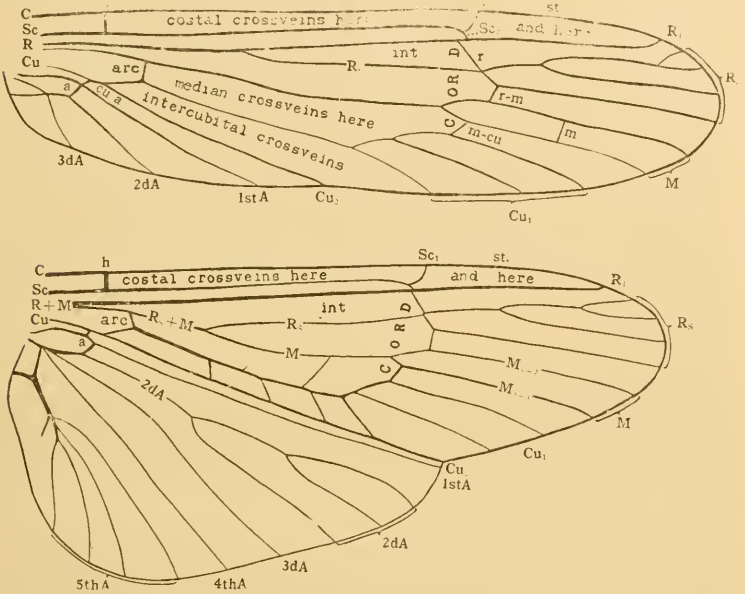

Fig. 1. Diagram of wing venation in the Plecoptera. The principal veins are designated by letters: *C*=Costa, *Sc*=Subcosta, *R*=Radius, *M*=Media, *Cu*=Cubitus, *A*=Anal, *Rs*=radial sector, the principal branch of the Radius. A plus sign between letters indicates these veins are fused together. The more typical crossveins are designated as follows: *h*=humeral crossvein, *r*=inter-radial crossvein, *r-m*=radio-median crossvein, *m*=median crossvein, *m-cu*=medio-cubital crossvein, *cu-a*=cubito-anal crossvein. Other veins and areas are designated as follows: *arc*=arculus which is a crossvein to which is often added a deflected basal portion of either of the veins it connects; *st*=stigma, a thickening in the costal space beyond the tip of the sub-costal vein; *a*=anal cell; *int*=inter-radial cell; CORD=the cord, a line of transverse joinings, composed of crossveins and the bases of principal forks, extending from the stigma obliquely backward to the cubital vein. The broad area bounded externally by the cord is sometimes spoken of as the wing disc.

veins in the middle and the crossvein that delimits the anal cell at the rear. The outer line of bracing is called the transverse cord (or, more briefly, simply the cord).

Three principal crossveins, together with portions of the veins they connect enter into its composition. These are the interradial, the radio-median and the medio-cubital crossveins,—all rather constantly present, unless eliminated by fusion of the adjacent veins at the point where they would normally be present. The cord divides the wing broadly into inner and outer fields. The middle portion of the wing lying between the arculus and the cord is often referred to as the wing disc. The point of origin (separation from vein R1) of vein Rs in the fore wing and the point of separation of veins Rs and M in the hind wing are often stated in terms of the distance between the arculus and the cord. This distance is measured along the vein in front (R1 in the fore wing, Rs in the hind wing).

The costal vein is always simple and borders the wing at the front.

The subcostal vein is typically forked at its tips with forks that are short and divaricate and that usually simulate crossveins, one joining costa, the other joining radius. The latter is usually longer and stronger so that the subcosta seems to end in the radius, but in Leuctra and Perlomyia it seems to end in the costa. Its tip surpasses the cord in Acroneuria and a few of the larger Perlas, but in most species it does not reach the level of the cord, and it is much shortened in Alloperla. Always it is a weak vein, and tends to fade out along with the annexed costal crossveins.

The radius is a strong vein, which with its branches supports the wing apex. The radial sector bears a variable number of branches, that are generally in a unilateral arrangement (rarely twice dichotomously forked as in the typical insect wing) and all springing from the posterior side. The point of origin of the hindmost branch and the point of separation of the sector from R1 at its base in the fore wing, and the extent of basal fusion of the sector with the median vein in the hind wing furnish useful systematic characters.

The median vein is usually two-branched, there being a single simple fork the base of which enters into the composition of the cord. Rarely, as in *Perla venosa* (Pl. 11, fig. 8) there appears to be the full typical complement of four branches. Often a deflected bit of the base of media enters into the composition of the arculus.

The cubital vein is typically two-branched, with often some accessory branches on the tip of Cu1. These are

generally arranged unilaterally, springing either from the posterior side as in Perla or from the anterior side as in Perlinella. In Alloperla and Chloroperla Cu2 becomes greatly abbreviated.

The anal veins are usually three in the fore wing and five in the hind wing, variously reduced, variously spaced, and variously branching. They furnish important systematic characters, that are only to be studied in wings fully outspread. In the hind wing all of these but the first are branched in the Pteronarcidae. The second one is most extensively and remarkably branched in *Acroneuria arenosa* (Pl. 16, fig 2). Between the bases of the first and second lies the anal cell, an important feature of wing topography, especially in the fore wing, where, fortunately, it may be examined in the wings when closed over the back.

The venation as a whole is remarkably instable. Characters cannot be stated with the same definiteness as in the higher orders. Every statement must admit of exceptions; and he who examines the venation of a stonefly while using keys and descriptions should examine all the

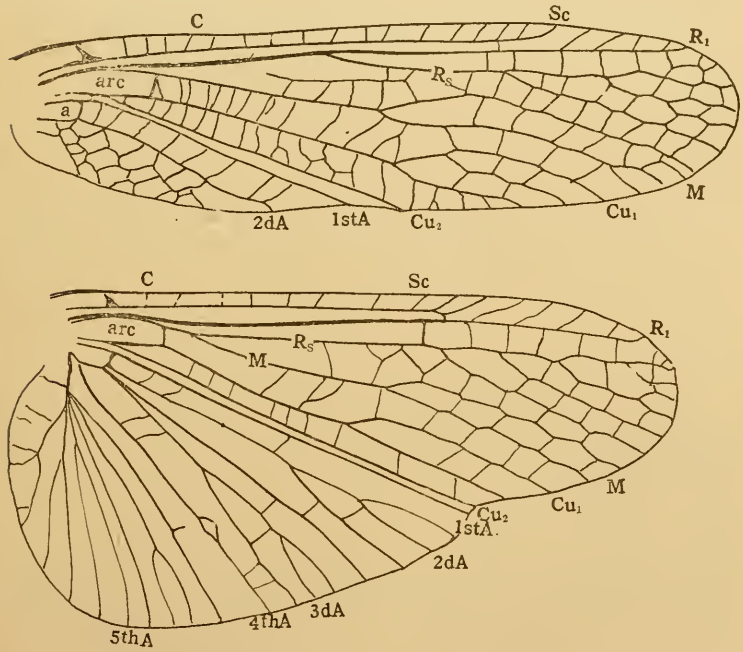

Fig. 2. Wings of *Pteronarcys proteus* Newm.

wings. Three at least out of four will usually be found in agreement.

Much confusion in key-making in the past has arisen out of too great dependence on such characters as the branching of the radial sector and the number of crossveins in the several series. Occasionally the normal male of a species would go by the key into one genus and the female into another. In order to determine what characters may be trusted and how far trusted, the senior author has made variation studies of a few series of wings in the Perlidae, and the results are presented in the following pages.

Variation in Pteronarcys dorsata.—This was studied in 20 males and 8 females. The branching of the radial sector was as follows:

No. of branches	3	4	5	6	7
Times occurring ♂	3	28	42	7	
Times occurring ♀		12	13	6	1
Both ♂ and ♀	3	40	55	13	1

From this it appears that the radial sector is typically five branched: on the five typical branches extra twigs appeared in 19 out of the 112 wings.

The branching of cubital vein (vein M being interpreted as two branched) was as follows:

No. of branches	1	2	3	4
Times occurring ♂	1	31	41	4
Times occurring ♀	1	8	20	3
Both ♂ and ♀	2	39	61	7

Extra twigs occurred on the first, second and third longest of these branches 52, 13 and 2 times respectively.

Longitudinal rows of cells within the cubital fork occurred as follows:

No. of cell rows	1½	2	2½	3
Times occurring ♂ and ♀	1	34	19	2

with no significant differences between ♂ and ♀.

The number of crossveins in cell M varied about a different mode in fore and hind wing, as shown in the following figures:

No. of crossveins	1	2	3	4	5	6	7	8	9	10	11
Times occurring, f. wing					1	13	19	15	2	5	1
Times occurring, h. wing	1	8	25	16	6						

The number of cells in the irregular meshwork in the space between veins R and R2 beyond the cord varied from 3 to 12, with the mode at 5 but with chaotic distribution of the variants.

Fusions between principal veins, eliminating the crossveins that normally stand between occurred in all 23 times and in 17 of the 28 specimens, in a single wing of a specimen 13 times; in front wings 6 times; in hind wings 16 times; between veins Rs and M 7 times; between veins M and Cu 13 times; between the branches of vein M 3 times.

Variation in Perla varians.—Walsh, the describer of this species, noted its remarkable variability and gave it an appropriate name. We have had no long series of specimens from any single locality, and have used seven specimens collected together at one time at Elkhart, Ind.,

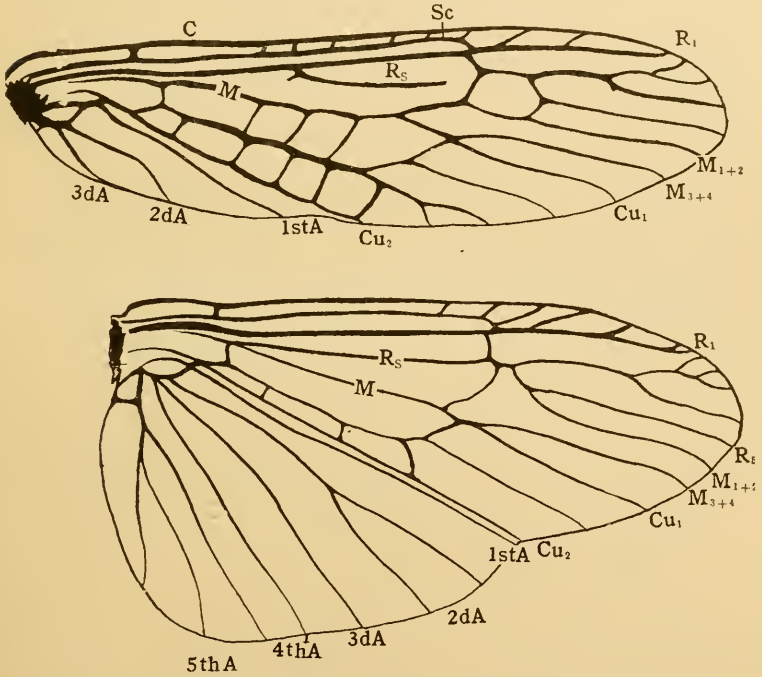

Fig. 3. Wings of *Perla varians* Walsh.

for the study of just a few wing characters connected with the cord. The radial sector was 3-branched in 25 of the 28 wings, two branched (had a single fork) in the other two.

It has been noted by every one that this species tends to preserve a cell adjacent to the cord in the space between veins Rs and M. The variation in respect to extra crossveins in this space is as follows:

No. of extra crossveins	0	1	2
Times occurring, fore wing	7	6	1
Times occurring, hind wing	7	7	

Thus it will be seen that such a cord cell (inclosed externally by the extra crossvein) was present in just half of these wings. It was absent from all four wings of two of the specimens and was present in all four in two other specimens.

Variation in Perla capitata.—This was studied in 18 specimens, 9 males and 9 females, all from Ithaca, N. Y. Crossveins in the space between veins C and Sc varied as follows:

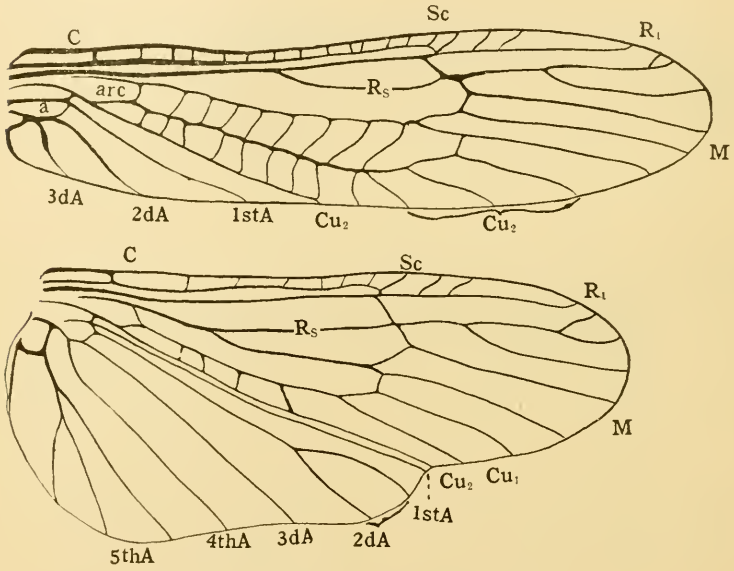

Fig. 4. Wings of *Perla capitata* Pict.

No. of crossveins	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Times occ., fore wing						1	5	7	4	8	5	2	3	0	1
Times occ., hind wing	1	7	11	10	1	5	0	1							

showing the mode to be 12 in the fore wing and 5 in the hind wing.

The costal crossvein in the apical space varied as follows:

No. of crossveins	2	3	4	5	6	7	8
Times occurring	1	7	16	27	13	7	1

Fore and hind wing alike.

The crossveins in the median space varied as follows:

No. of crossveins	1	2	3	4	5	6	7
Times occurring, fore wing	1	0	8	11	10	2	3

These are wanting entirely in the hind wing.

The crossveins in the cubital space varied as follows:

No. of crossveins	1	2	3	4	5	6	7	8	9	10	11
Times occurring, fore wing					2	3	12	10	7	1	1
Times occurring, hind wing	1	2	2	6	7	7	8	1	2		

Showing a wider range of variability in the hind wing but a mode at 7 in both wings.

Extra crossveins occurred among the branches beyond the cord, 89 of them in all in the 72 wings, and more often several in one specimen than singly. These occurred 27 in males, 62 in females; 36 in fore wings, 53 in hind wings; 68 in interspaces of the radial sector, and 21 farther rearward.

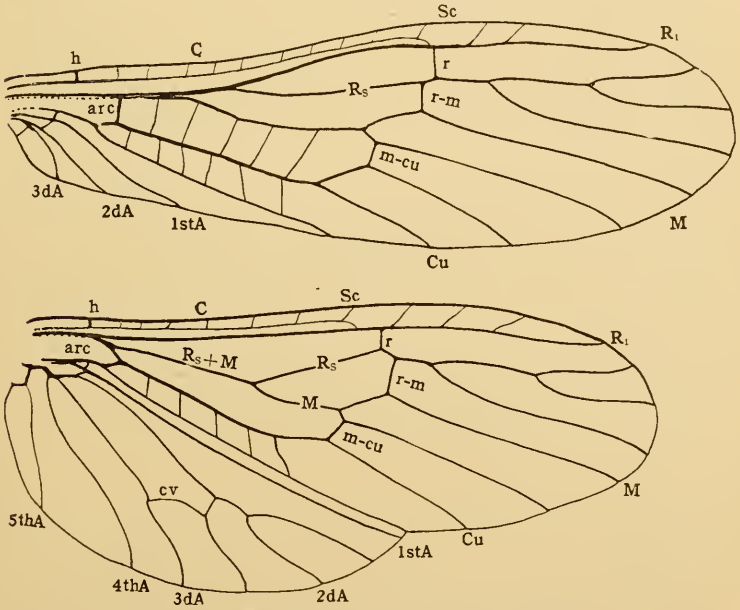

Fig. 5. Wings of *Neoperla clymene* Newm.

The branching of the radial sector is in this species rather constant, though differing in the sexes. It is 4-branched in the male and 5-branched in the female. But 3 wings out of the 72 departed from these numbers.

The branching of the tips of vein Cu is exceedingly inconstant. Though in number the tips range only from 2 to 5, fifteen types of branching were noted among them. But

three of these were of common occurrence: the others were erratic.

There is much variation in the position of the crossveins, *r-m* and *m-cu*, in relation to the adjacent forks, affecting thus the position of the cord. The crossvein was situated before the fork of the median vein 5 times, and beyond that fork 67 times. Likewise the terminal crossvein in the intercubital space of the fore wing was situated before the fork of the cubital vein 47 times, opposite that fork 5 times, and beyond that fork 20 times.

Variation in Neoperla clymene.—This was studied in 25 specimens, 13 males and 12 females, collected at Ithaca, N. Y. The variation in the number of crossveins between costal and subcostal vein was as follows:

No. of crossveins	1	2	3	4	5	6	7	8	9	10	11	12
Times occurring, fore wing							5	9	10	14	8	4
Times occurring, hind wing	1	2	2	2	3	11	18	10	1			

Thus the normal number is 10 in the fore wing and 7 in the hind wing.

The variation in costal crossveins in the apical series was as follows:

No. of crossveins	1	2	3	4	5
Times occurring, fore wing	7	20	19	4	
Times occurring, hind wing	5	20	23	1	1

Thus, 2 or 3 is the normal number for this species with no material difference for fore and hind wings.

The variation in crossveins of the median series is as follows:

No. of crossveins	3	4	5	6	7
Times occurring, fore wing	2	12	21	12	3

These are entirely absent from the hind wing.

The variation in crossveins of the cubital series was as follows:

No. of crossveins	3	4	5	6	7	8
Times occurring, fore wing	1	13	14	16	5	1
Times occurring, hind wing	2	17	22	8	1	

Thus the mode is at 6 in the fore wing and at 5 in the hind wing.

Only 25 extra crossveins occurred in all these wings, all of them in 12 specimens, and 10 of them in two specimens. All but 6 of them were in the apical radial area.

The variation in branches of the radial sector was as follows:

No. of branches	2	3	4
Times occurring ♂ and ♀	9	84	7

There was practically no difference between fore and hind wing, nor between the sexes. There was a little

variation in depth of forks: the mode is shown in our figure of the normal wing.

The variation in branches of the cubital vein was as follows:

No. of branches	1	2	3	4
Times occurring, fore wing		42	7	1
Times occurring, hind wing	46	4		

The point of origin of the radial sector is often of importance in stonefly wing topography, but it varies considerably in this species. Estimating in tenths of the distance from the arculus to the cord outward along the wing disc it varies as follows:

Origin at	3	4	5	6 tenths of the disc
Times, fore wing	10	40		
Times, hind wing		2	33	15

Thus the radial sector in the fore wing normally springs from vein R1 at two-fifths the length of the wing disc, and in the hind wing it separates from vein M halfway out.

The matchings of the two anterior crossveins of the cord, *r* and *r-m*, at their junction with the radial sector determines the course of the cord. Sometimes these are opposite and erect. Oftener they are ajog either in or out. The variation in this respect in these wings stated in

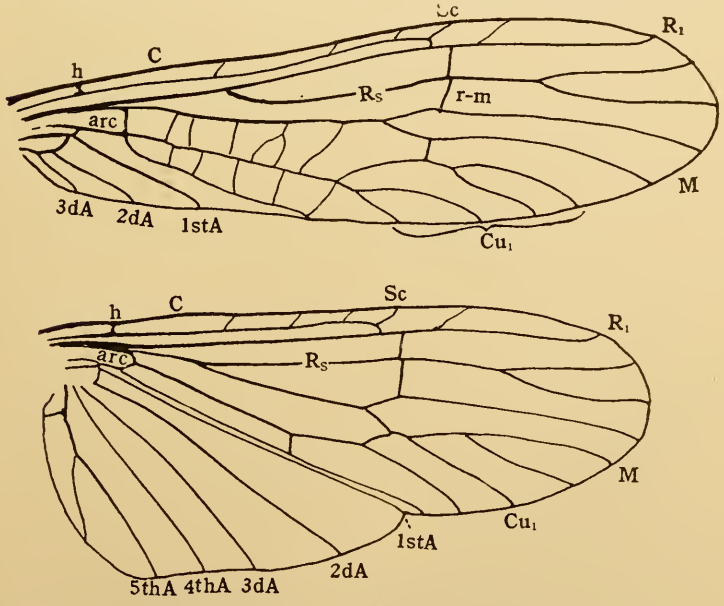

Fig. 6. Wings of *Isoperla bilineata* Say.

terms of the *r-m* crossvein (whether it is in or out in relation to crossvein *r*) was as follows:

A jog	in	erect	out
Times occurring, fore wing	34	9	7
Times occurring, hind wing	5	5	41

Variation in Isoperla bilineata.—This was studied in 24 specimens, 12 males and 12 females, collected at Old Forge, N. Y.

The variation in crossveins in the space between costal and subcostal veins was as follows:

No. of crossveins	3	4	5	6	7
Times occurring, fore wing	3	15	26	33	1
Times occurring, hind wing	25	23			

Thus the mode in the fore wing was 5 and in the hind wing 3.

The variation in crossveins in the apical space was as follows:

No. of crossveins	1	2	3
Times occurring, fore wing	30	17	1
Times occurring, hind wing	40	7	1

Thus a single crossvein is the mode for both wings.

The variation of crossveins in the median space was as follows:

No. of crossveins	0	1	2	3	4	5	6
Times occurring, fore wing				8	20	9	11
Times occurring, hind wing	47	1					

Thus 5 is the mode for the fore wing while in the hind wing they are normally lacking.

The variation in crossveins in the intercubital space was as follows:

No. of crossveins	1	2	3	4	5	6	7
Times occurring, fore wing			2	17	20	8	1
Times occurring, hind wing	43	5					

Here again the mode for the fore wing was 5, and as in the preceding the ranges of variation for fore and hind wings did not overlap.

The crossvein *m-cu* was present in a third of the wings and had disappeared by fusion in the other two-thirds. The fusion was for a distance about equal to the length of the radial crossvein in most cases but it was often longer and in one wing it extended to the wing border.

The matchings of the two crossveins of the cord, *r* and *r-m*, upon the radial sector was as follows:

Jog of *r-m* in relation to *r*	in	erect	out
Times occurring in fore wing	6	13	29
Times occurring in hind wing	3	9	36

The branches of the radial sector were 2 (a single fork)

except in 1% of the specimens that had an extra fork on one of the vein tips, but the depth of the main fork varied as follows (expressed in tenths of the distance from the cord to the wing tips) :

Tenths of distance	2	3	4	5	6
Times occurring, fore wing		3	9	21	15
Times occurring, hind wing	2	2	13	22	9

Thus the modal position for the fork is in the middle of this space.

The tip of the subcostal vein joins vein R1 modally a distance before the cord about equal to the length of the

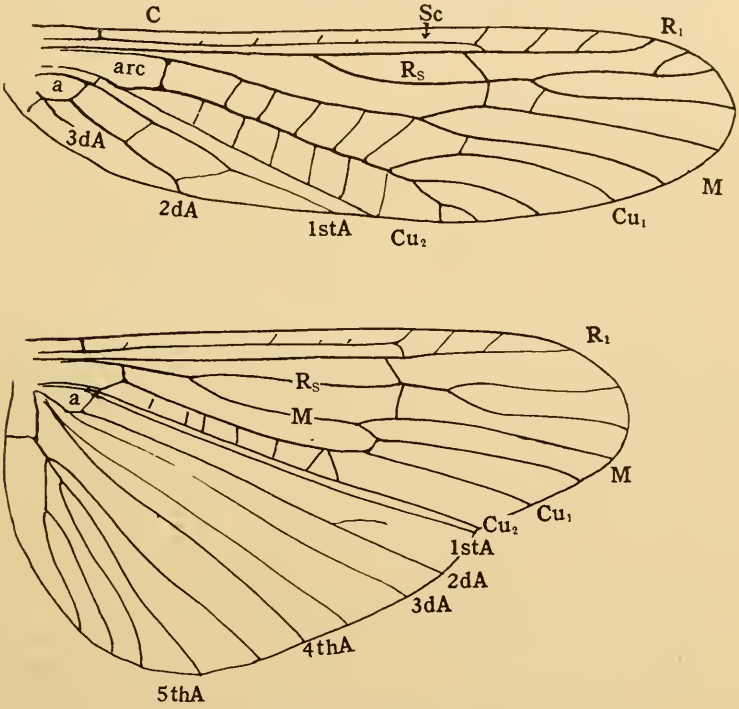

Fig. 7. Wings of *Perlinella drymo* Newm.

crossvein *r* and the variants in the fore wing run generally to a little greater length of subcosta; in the hind wing generally they run a little shorter.

Variation in Perlinella drymo.—This was studied in fifteen specimens, 9 males and 6 females from Elkhart, Ind. The crossveins in the space between the costal and subcostal veins have so atrophied in this species that they could not be counted with certainty but there ap-

peared to be vestiges of modally 3 in the fore wing and 2 in the hind wing with a range from 1 to 5. The costal crossveins in the apical space, however, are strong. They varied as follows:

No. of crossveins	1	2	3	4
Times occurring, fore wing	1	14	12	3
Times occurring, hind wing		7	20	3

The crossveins in the median space varied as follows:

No. of crossveins	2	3	4	5
Times occurring, fore wing	2	12	9	7

with none in the hind wing in this space.

The crossveins in the intercubital space varied as follows:

No. of crossveins	3	4	5	6	7	8	9	10
Times occurring, fore wing			5	7	11	7	1	1
Times occurring, hind wing	1	3	7	8	10	1		

Thus there is a wide range with the mode at 7 in both wings.

Crossveins between the anal veins of the fore wing beyond the anal cell are a distinctive mark of this genus. They varied as follows:

No. of crossveins	2	3	4	5
Times occurring	4	12	9	5

The *m-cu* crossvein is very variable in having a modal length of about eight-tenths of that of the *r-m* crossvein (infrequently longer), but often disappearing by fusion of adjacent veins, the fused portion sometimes attaining once or twice that length.

The radial sector is normally 2-branched (a single fork) but an extra twig at the tip of the anterior branch of the fork occurred in three specimens and in three wings of one specimen. The depth of the main fork varied from origin at the cord to six-tenths the distance beyond the cord, the mode being at three-tenths that distance.

The branches of vein Cu pectinately arranged on the anterior side (a character of this genus) vary in number from 1 to 5, with the mode at three in the fore wing and two in the hind; but six wings showed slight departures from the typical pectinate arrangement of these branches.

Variation in Acroneuria lycorias.—This was studied in 75 specimens, 25 males and 50 females, collected at one time and place (Ithaca, N. Y., in June, 1905). The number of branches of radial sector was as follows:

No. of branches	3	4	5	6	7
Times occurring, fore wing	1	35	55	6	3
Times occurring, hind wing		19	72	9	

showing it to be typically 5-branched in both fore and hind wing.

The branching of the vein Cu1 was as follows:

No. of branches	2	3	4	5	6	7
Times occurring, fore wing		1	35	55	6	3
Times occurring, hind wing	19	70	11			

showing it to be typically 5-branched in the fore wing and 3-branched in the hind wing.

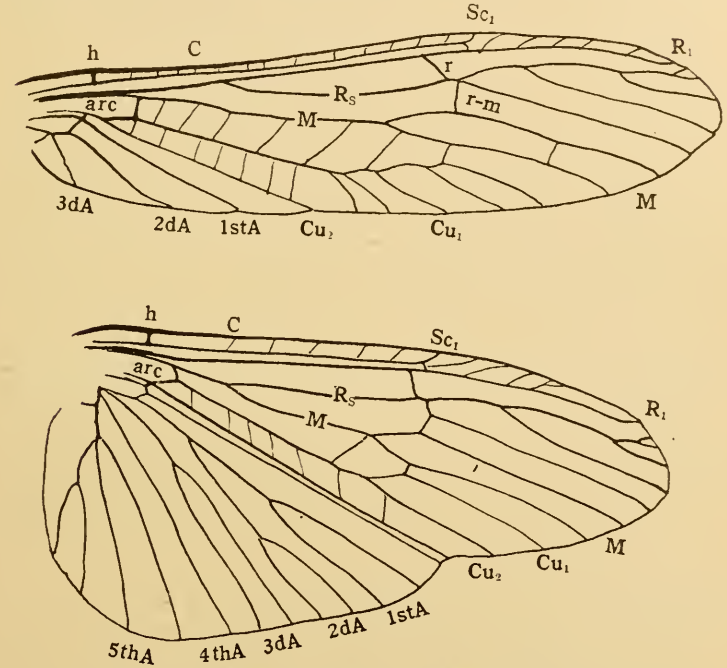

Fig. 8. Wings of *Acroneuria lycorias* Newm.

The crossveins in the median space were as follows:

No. of crossveins	0	1	2	3	4	5	6	7	8	9
Times occurring, fore wing				1	11	23	41	18	7	2
Times occurring, hind wing	14	59	16	4						

In the forewing 6, in the hind wing 1, is the mode.

The crossveins in the adjacent intercubital space showed no such difference.

No. of crossveins	5	6	7	8	9	10
Times occurring, fore wing	5	13	38	32	9	3
Times occurring, hind wing	8	20	39	22	9	2

The genus Acroneuria takes its name from the presence of extra crossveins in the portion of the wing beyond the cord in the type species; but in *A. lycorias* such crossveins were quite lacking in most specimens. In all 80 extra

crossveins were counted in all the spaces between the tips of veins Rs and M in all the wings of these 75 specimens and only in a minority of the specimens did they occur singly. Most of them were between the branches of radius, the first, second, third and fourth longest interspace containing 27, 34, 11 and 1 crossveins respectively, and the space between Rs and R1 having 4. The foremost interspaces between the branches of the cubital vein and the one next behind it contained 11 and 6 extra crossveins respectively in all. The crossvein conjoining the two branches of the cubital vein and the one next behind it contained 11 and 6 extra crossveins respectively in all. The crossvein conjoining the two branches of vein M (with the branches wide apart) was absent in about 8 per cent of the wings, and was absent from all four wings of one single specimen. It was absent from at least one wing of 19 specimens. In addition to this it had disappeared by fusion of these two branches together in 44 cases, the extent of the fusion equalling usually the nor-

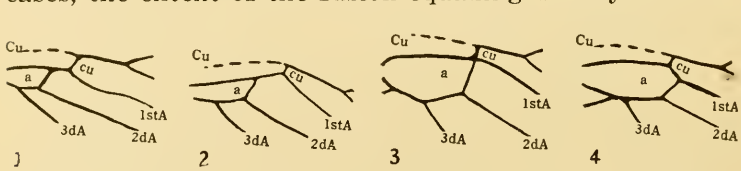

Fig. 9. Diagram of the relation between the cubito-anal crossvein (*cu*) and the anal cell (*a*): 1, in *Perla bilobata;* 2, in *Perlodes irregularis;* 3, in *Peltoperla anna;* 4, in *Perla capitata.*

mal length of the crossvein when free, but sometimes running to four or even five times that length.

The three regular crossveins that enter into the composition of the cord, *r*, *r-m*, and *m-cu*, are always present or replaced by fusion of adjacent veins. The foremost one, *r*, is most constant and does not disappear by fusion nor vary greatly in length or position. The second, *r-m*, was present in all 4 wings of 38 specimens and in at least two wings of all the specimens. The third crossvein, *m-cu*, was present in 40 wings, and fused out in all the others, the extent of the fusing ranging up to four times its normal length when present.

Conclusion.—All characters are good characters if used with discretion. Though crossveins and branches vary in number, there is a range and a disposition of both that is constant for the species. But more dependable than these are the relative positions of parts at the principal points

of bracing of the wing—arculus, cord and anal cell. We have found a very dependable character that has scarcely been noticed hitherto in the relation between the cubito-anal crossvein of the forewing and the anal cell. This crossvein in a series of genera in the difficult family of Perlidae, shifts its position from the front of the anal cell out beyond the apical angle along the base of the first anal vein as indicated for a series of genera in the accompanying diagram. This has furnished a clue to affinities in some of the difficult cases.

Genital Characters.

Male.—The terminal abdominal segments of male stoneflies are variously modified to serve as copulatory organs. Since the sperm ducts open at the apex of the 9th segment, the 9th and 10th segments are always involved, and the 8th, 7th and 6th and even the 5th may be as well. As is well known, there are 10 segments that usually form complete rings in the abdomen, and what is supposed to be an 11th segment is represented by three plates, convergent over the terminal anal opening—a median dorsal supra-anal plate and a pair of ventral subanal plates that bear the cerci or tails. These are the same in both sexes. In copulation the male climbs upon the back of the female, drops the tip of his abdomen below the level of hers, and recurves it, turning the end segment upward and forward, grasshopper fashion, beneath hers, bringing the hollow up-turned end of the genital scoop of the 9th segment into apposition with the subgenital plate at the apex of the 8th segment in the female. The commonest feature of the male copulatory apparatus of the order is the development of recurved genital hooks that can be thrust beneath the subgenital plate of the female to draw it downward and open the vulva. These are most simply developed as a pair of processes arising from the subanal plates and curving forward. In the Nemouridae there is a very great range of form assumed by the subanal lobes. In the genus Nemoura they may be as simple as in the female, or they may be very large. In Leuctra they are divided into two processes, one slenderer than the other and in Taeniopteryx (in part) they are unsymmetrical.

A single median hook, in some cases becoming a long probe, and sometimes exceedingly complicated, is often developed from the supra-anal lobe. Paired hooks may be developed from the apex of the 10th segment, and this segment may become deeply cleft and the hook arising from the hind angles of the cleft may become very large.

For holding securely in copulation, the dorsal apical margin of one or more of the segments in front of the genital hooks may be armed with backwardly directed teeth, lobes or spines. The subgenital plate of the female is gripped firmly between the genital hooks and these opposing processes.

The sperm ducts, opening at the apex of segment 9 on the ventral side, usually terminate in a retractile penis. A subgenital prolongation of that sternite to rearward, upturning and more or less scooplike at the end, accommodates this organ, which has been observed in comparatively few stoneflies, it being normally wholly concealed.

The figures of plate 4 will serve to illustrate these structures. Figures 1, 2 and 3, representing three views of the end of the abdomen in the male of *Acroneuria ruralis*, show paired genital hooks arising from the subanal plates and curving forward over the rim of the 10th tergite. The prolonged 9th sternite bears on its under side a roundish percussion disc or hammer, with which the male is said to drum upon the surface on which he stands. The penis is normally concealed, as in these figures; but it may be extruded as shown in the two figures of *Acroneuria pacifica* shown in the same plate (Figs. 11 and 12). It is an eversible sac controlled doubtless by blood pressure. It is capable of extreme telescopic elongation in some forms, as shown for *Neoperla clymene* in Pl. 24, fig. 2. It is chitinized very little in most forms, but occasionally bears well developed serratures upon its sides, as shown for *Perlinella drymo* in Pl. 24, fig. 7.

A greater complication of the male genital apparatus is shown for *Perlodes signata* in Figs. 6 to 10 of Plate 4. The disarticulated terminal segments of the male abdomen are shown separately in figures 5 to 10, and they are all shown in their proper relation and with the penis added in figure 6. The 10th segment is divided by an apical mid-dorsal cleft and the rear angles beside this cleft rise in long recurved genital hooks. The supra-anal process is greatly enlarged, with a U-shaped organ whose base is strongly attached within the base of the 10th tergite, and whose apex curves upward and forward as a median unpaired genital hook or probe trailing a membranous flap from its tip, and bearing a pair of thin flat subspatulate lateral stylets. In copulation the pointed rear end of the U-shaped supra-anal process is tilted forward between the hooks of the 10th tergite which support it on either side. Its wedge-shaped point serves as a probe to lift the sub-

genital plate. The lateral stylets, directed backward and spread apart with the change of position serve as a guide to the large soft fleshy penis that issues from the apex of the 9th segment beneath and rises and curves forward following the curvature of the ventral surface of the supra-anal process, passing between the stylets, its tip protected by the long membranous flap appended to the tip of that process. The penis is a large erectile cylindric organ a third as large in diameter as is the abdomen. It is soft and white except for a sub-apical ring of thin pale brown chitin. This ring is thinner on the ventral side, where arise a pair of soft, slender, delicate, divergent, white palpiform sensory organs, each of which has a length equal to the diameter of the penis. The subanal plates do not appear to be involved in the copulatory apparatus of this type.

Female.—Only the sternite of the 8th abdominal segment and the portion of the 9th segment adjacent thereto are modified as accessory organs of reproduction in this sex. The oviduct terminates midventrally between these two segments and the 8th sternite is generally prolonged posteriorly into a subgenital plate that overlaps the aperture. The form and size of this plate, and the degree of its demarcation from the remainder of the sternite furnish useful characters for the discrimination of species.

Since many species are known only from the female, which sex in its structure offers fewer clues to relationships, it may well occur that some of the species will not have been placed next to the ones with which they are most closely allied.

Tails or cerci.—Excepting in the family Nemouridae, the tails are long, many-jointed and tapering, the segments reaching their maximum number in the larger species of Acroneuria, where the basal segment is very large, and several of the close-ringed following segments are ill-defined. Beyond the base the segments regularly increase in length to rearward, the terminal segments being from three to six times as long as wide. The pubescence covering the segments varies much in length and density and is in some genera interspersed with apical verticils of long bristles, that become conspicuous in Perlinella and its allies.

The reduced, mostly one-segmented, tails of the Nemouridae, often remarkably modified as accessory organs of reproduction, are shown for all our species on plates 34 to 46.

CLASSIFICATION.

The members of the order Plecoptera, or stoneflies, have four reticulate, membranous wings; the hind wings are generally much broader than the fore wings, are usually folded, and together with the fore wings mostly lie flat upon the abdomen when at rest. The mouthparts are of the biting type of structure, but are frequently poorly developed. The metamorphosis is incomplete.

Adult stoneflies, as a rule, are of a dark brown color; some (Chloroperla, Alloperla, Isoperla) are yellow or greenish. The body is elongate and flat. The head bears a pair of long, slender, filamentous, many-segmented antennae. The last segment of the abdomen bears two many-segmented cerci or tails, except in the Nemouridae, where the cerci are composed of a few segments or of only one. The legs are slender with three-jointed tarsi and two tarsal claws. There is a pair of compound eyes and there are three, in some genera, two ocelli. In some species the wings of the male are considerably reduced and in a few instances (Capnella) the males are wingless. The venation of the wings varies considerably, especially on the outer half of the wing, and can be used for distinction of genera. The hind wing is peculiar in that the radial sector at its base is fused with the median vein. The structure of the genitalia is fairly constant within the species and in most genera the genitalia of both males and females furnish excellent characters for specific determinations.

The stoneflies constitute one of the smaller orders of Neuropteroid insects. In North America, north of Mexico, we find the following four families represented: Pteronarcidae, Perlidae, Nemouridae and Capniidae. Originally these families were considered as tribes or subfamilies under the single family Perlidae; of late, however, there has been a tendency to multiply the number of families.

In the following pages are described 207 species, grouped in 24 genera. We have not adopted all the genera that have been proposed of late. Many of the new ones, bearing cumbrous names, are based on secondary sexual characters peculiar to one sex and so trivial they can hardly be considered as of more than specific value. Insofar as we have been able to recognize these nominal genera and to assign species to them we have retained the names of all as subgenera, and have so included them all in the systematic list at the end of the volume.

Key to the Families.

1. Anal area of forewing with two or more full rows of crossveins ---------- *Pteronarcidae*
   Anal area of forewing either without crossveins or when present there is only one row---------- 2

2. Well developed, many-segmented, cerci (tails) present ---------- 3
   Cerci one-segmented or much reduced—*Nemouridae*

3. Forewings with a series of median and cubital crossveins; radius and media incompletely fused and separating gradually at the base except in small greenish forms---------- *Perlidae*
   Forewings with only one or two median and one cubital crossvein; radius and media completely fused at base and separating at a rather sharp angle ---------- *Capniidae*

Family PTERONARCIDAE.

This is a small family of mostly large stoneflies including in our fauna but two genera. They are distinguished from other stoneflies of our fauna by reticulate venation extending in the fore wing from the front all the way rearward across the anal veins. There is no distinct transverse cord developed. The wings are dusky with veins of darker brown. Brachypterous males occur in at least one species of Pteronarcella. Legs rather long, with middle segment of the tarsus half as long as the basal segment. The mandibles in the adult are rudimentary and the segments of the palpi appear to be multiarticulate, their walls being made up of many irregular chitinous half rings. The mandibles of the nymphs are heavy and stoutly toothed at the apex, adapting them for feeding upon the vegetable trash that gathers in the eddies and at the sides of streams. The gills are in pedicellate tufts, on the ventral side of the thoracic end of two or three terminal segments; and so slight is the transformation that these are carried over into adult life as small but readily recognizable rudiments. The supra-anal process of the male is highly developed as an accessory organ of reproduction, and the tenth abdominal segment is in this sex greatly reduced and almost included within the expanded and ventrally produced rear end of the ninth segment. The genus Pteronarcys is distributed across the continent and into northern Asia. The genus Pteronarcella is known only from the mountains of the western United States.

This family, having recently received adequate treatment at the hands of Lucy Wright Smith (Trans. Am. Ent. Soc. 43: 433-463, 1917), we have given it rather brief treatment, especially as to bibliographic and distributional records, and our figures for the species of Pteronarcys are copied from her plates.

Key to the North American Genera of Pteronarcidae.

1. Large species (1¼ to 2½ inches in length); forewing with two rows of cross-veins in anal field, with crossveins between R and Rs and between Rs and M before the cord; hind wing with more than 10 long branches of anal veins_____*Pteronarcys*

   Smaller species (one inch or less) forewing with only two rows of crossveins in anal field; no crossveins between R and Rs and M before the cord; hind wing with fewer than 10 long branches of anal veins.
   _____ *Pteronarcella*

Genus PTERONARCYS Newman.

1838. *Pteronarcys* Newman, Ent. Mag., 5:175.
1907. *Pteronarcys* Klapalek, Bull. Internat. Ac. Sci. Bohem., pp. 1-13.
1917. *Pteronarcys* Smith, Trans. Amer. Ent. Soc., 43:437.

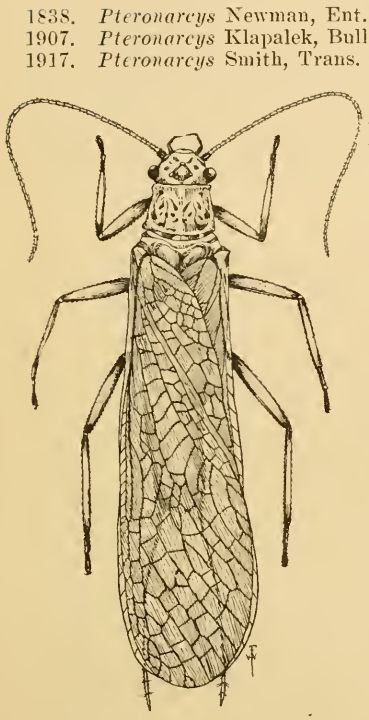

Fig. 10. *Pteronarcys dorsata* Say.

The largest of stoneflies, with stout depressed linear bodies, long antennae, short tails and broad heavily net-veined wings. Color dark brown, varied (sometimes rather brightly in life) with intersegmental markings of rufous, orange and yellow. Ocelli 3 in an equilateral triangle. Frontal tubercles prominent, supra-antennal plate well developed.

Prothorax broader than long, bearing a pale median yellow line and lateral embossed markings upon the disk. First tarsal segment twice as long as the second and the third a little longer than the two preceding it. Nymphal gills persistent (13 pairs) shrivelled and inconspicuous. Wings concolorous, or somewhat clouded on the veins.

Abdomen depressed-cylindric, paler beneath; tails brown, paler at the base. Genitalia highly specialized and very peculiar, meriting special study because they hold almost the only reliable criteria for distinguishing the species. These being made the basis of the following keys, it has been necessary to treat the two sexes separately.

These insects are crepuscular or nocturnal in habits and are consequently little observed. Hardly anything has been written of their habits. Newport (Trans. Linn. Soc. Lond., 20:433) records that *P. proteus* was found in great numbers at a waterfall in Magog River, hanging to the rocky sides that were wet by spray, or concealed in the crevices of the rocks. He also states that *P. regalis* (*P. dorsata*) was taken by Doubleday on wet evenings. Hagen

(Stett. Ent. Zeit. for 1877, pp. 477-489) records some observations on the mating habits of the latter species. The senior author in 1923 observed *P. princeps* emerging from the streams in Andreas Cañon, San Jacinto Mts., California. The imagos left their cast-off skins clinging to the down-stream face of the huge granite boulders that stood partly immersed in the water, and themselves immediately sought shelter in less exposed places, usually about the log-drifts in the stream.

Genotype, *Perla dorsata* Say.

Key to the species of Pteronarcys.

Males.

1. Ninth abdominal sternite prolonged backward far beyond the tip of the tenth segment and bifid at the tip of the prolongation. Tenth abdominal tergite divided and produced backward in two appendage-like lobes 2
   Ninth abdominal sternite truncate, but little produced and entire on tip. Tenth tergite divided into two erect more or less rounded lobes 3

2. Tips bordering the notch in the apex of the ninth sternite straightish, not decurved. Tips of the appendage-like divisions of the tenth tergite upcurved ..... *dorsata*
   Tips bordering the notch in the apex of the ninth sternite decurved. Tips of the appendage-like divisions of the tenth tergite straightish, scarcely curved upward ..... *nobilis*

3. Supra-anal plate huge, decurved, laterally flattened and forked under the tip 4
   Supra-anal plate slender, almost spinous, erect or curving forward 5

4. Erect lobes of the divided tenth tergite rather broadly rounded ..... *californica*
   Erect lobes of the divided tenth tergite rather narrow, much higher than wide ..... *princeps*

5. An anteriorly-directed median dorsal process arising from the rear and lying upon the ninth tergite ..... *protcus*
   No such process present; 9 rounded above ..... *biloba*

Females.

1. Posterior margin of the subgenital plate but little produced backward ---------- 2
   Posterior margin of the subgenital plate conspicuously extended backward, with teeth or processes ---------- 3
2. Margin entire ----------*dorsata*
   Margin with a small rectangular median excision ----------*nobilis*
3. Bearing a pair of flat triangular processes on its ventral side ---------- 4
   Bearing very slender or very minute processes-- 5
4. Entire sternite deeply cleft to form the two broad processes ----------*biloba*
   Processes upon the apex of the subgenital plate that arises before the apical margin of the sternite ---------- 6
5. The processes are somewhat equilateral triangles approximated at base ----------*californica*
   The processes are very elongate triangles, twice as high as broad and more widely separated at base ----------*princeps*
6. Processes arise before the apex of the segment and are slender and recurving, and as long as the segment ----------*proteus*
   Processes a minute pair of teeth at the apex of a broadly ovate lobe that extends beneath segment 9 ----------*comstocki*

Pteronarcys dorsata Say.

(Plate 7, figs. 1, 2, text fig. 10.)

1823. *Sialis dorsata* Say, West. Quart. Rept., 2:164.
1838. *Pteronarcys regalis* Newman, Ent. Mag., 5:176.
1917. *Pteronarcys dorsata* Smith, Trans. Am. Ent. Soc., 43:446. (contains full bibliography of adult and nymph, 30 titles).

Male. Length to wing tips 40-47 mm.; of antennae 22-25 mm.; of tails 10-13 mm.; expanse of wings 70-80 mm.

Female. Length to wing tips 50-60 mm.; of antennae 22-26 mm.; of tails 12-15 mm.; expanse 86-106 mm.

The largest known stonefly. Dark brown, paler beneath and with indistinct yellowish intersegmental markings. Prothorax as wide as the head and slightly widened posteriorly, front margin and sides straight, its hind margin convex, and its angles abruptly produced in small tooth-like projections. The middorsal yellow line upon the disk is widened toward its ends and somewhat interrupted in

its middle portion by darker markings that extend across the disc. Trochanters yellowish and knees yellow in some specimens. Veins of the wings blackish and somewhat clouded. Abdomen pale yellow beneath.

Male. The ninth ventral segment prolonged rearward, covering and extending far beyond the 10th sternite, and forming a broad, trough-like lobe that bears a median straight-sided terminal notch. Segment 10 narrow below where covered by 9, but elongated rearward on the dorsal side and bifid into two long appendage-like lobes whose opposed edges are emarginate in their apical half and whose tips are strongly bent upward. Supra-anal plate developed as a sperm conveyor, unbranched, and with terminal eversible sperm cup. Sup-anal plates elongate, their tips projecting beyond the apex of the 9th sternite.

Female. The eighth sternite, truncate apically and not prolonged and showing no special demarcation of a subgenital plate. Normally the border is straight, but many abnormalities occur owing to wrinkling in drying. The soft lateral margins of the genital aperture may dry in such a way as to form a minute triangle on either side, the presence of which is responsible for at least one synonym.

Distribution.—Ohio River at Pittsburgh; Maine to D. C., to Tenn.; to Kan.; to Minn.; to Saskatchewan; to Alaska and Labrador. Common in small rivers of the central states where the nymphs live in the trash of the eddies below stony rapids.

Pteronarcys nobilis Hagen.

(Plate 7, figs. 3, 4.)

1861. *Pteronarcys nobilis* Hagen, Syn. Neuropt. N. A., p. 15. ♂
1873. *Pteronarcys pictetii* Hagen, Proc. Bost. Soc. Nat. Hist., 15:286. ♀
1917. *Pteronarcys nobilis* Smith, Trans. Am. Ent. Soc., 43:448 (contains full synonomy, 10 titles).

Male. Length to wing tips 31-34 mm.; of tails 12 mm.; expanse of wings 55-57 mm.

Female. Length to wing tips 45-48 mm.; of tails 11 mm.; expanse of wings 80-84 mm.

Color uniform dark brown above, obscure orange beneath, excepting the tip of the abdomen which is often shiny black beneath. There are often lateral apical spots of orange or rufous on the abdominal tergites. Wings smoky brown with darker veins. Inconspicuous yellow-

ish middorsal band on prothoracic disc, widened toward its ends.

Prothorax slightly broadened posteriorly, with straight sides, end convex margins, especially in the rear, and acute angles.

Male. Ninth ventral abdominal segment prolonged rearward, covering and extending far beyond the 10th sternite and ending in a notch the bordering lobes of which in lateral view are sharply decurved at tips. Appendage-like lobes of the divided 10th tergite a little shorter and slenderer than in *P. dorsata*, somewhat contracted before the apex and not sharply upcurved at tips. Supra-anal plate developed as a sperm conveyor, unbranched, and bearing a terminal sperm cup.

Female. Subgenital plate not separate from the sternite, apical margin very slightly produced and with a median rectangular notch in its margin.

Distribution.—Canada to Georgia, west to Kansas and Minnesota.

This species is very close to the preceding and only a careful examination of the genitalia will distinguish the males. It is less common than the preceding species, but if a specimen in the U. S. National Museum (a small male ticketed "Coquillett; Los Angeles, Calif.") is correctly labelled as to locality, it has a wider range. In the Eastern U. S. it flies during June and July.

Pteronarcys californica Newport.

(Plate 7, figs. 5, 6.)

1851. *Pteronarcys californica* Newport, Trans. Linn. Soc. Lond., 20:450.
1873. *Pteronarcys californica* Hagen, Proc. Bost. Soc. Nat. Hist., 5:284 (nymph).
1883. *Pteronarcys californica* Packard, 30th Rept. U. S. Ent. Com., pl. 39, fig. 8; 40, fig. 6; 44, figs. 1, 9.
1917. *Pteronarcys californica* Smith, Trans. Amer. Ent. Soc., 43:449 (contains full bibliography, 8 titles).

Male. Length to wing tips 33-40 mm.; expanse of wings 58-66 mm.

Female. Length to wing tips 41-46 mm.; expanse of wings 72-84 mm.

Color dark brown, paler beneath. Head blackish, supra-antennal plate ends in a sharp erect tooth. Median line on disc of prothorax obscurely reddish, widened toward its ends. Legs dark brown. Wings with blackish veins. Tails brown in middle, paler toward both ends. Pronotum nearly as long as broad, its front and sides straight, its hind margin convex, its angles obtuse.

Male. Ninth ventral segment little produced backward and not entirely covering the 10th sternite and set off at each side of the pleura by an impressed fold. Tenth tergite deeply divided above into two erect bluntly rounded lobes. Supra-anal plate developed as a corneous, and complicated sperm conveyor. Its superior margin runs out to rearward and ends in a free bifid tip; before this tip is a laterally flattened ventrally directed branch, that bears the sperm cup on its proximal side, just before an apical dilatation; subanal plates broad.

Female. Eighth ventral segment bears just before its apical margin two somewhat equilateral-triangular processes whose tips reach the middle of segment 9.

Distribution.—Montana to New Mexico and Washington to California.

This is the common species of our western mountains, where it is on the wing during June, July and August. The easternmost specimen we have seen is also the earliest in season, and was collected by G. A. Dean in Riley County, Kansas, on April 25.

Pteronarcys princeps Banks.

(Plate 7, figs. 7, 8.)

1907. *Pteronarcys princeps* Banks, Can. Ent., 39:327.

1907. *Pteronarcys fumipennis* Klapalek, Bull. Internat. Soc. Boh., p. 12 of reprint.

1917. *Pteronarcys princeps* Smith, Trans. Amer. Ent. Soc., 43:450.

Male. Length to wing tips, 36 mm.; of antennae, 21 mm.; of tails, 7 mm.; expanse of wings, 68 mm.

Female. Length to wing tips, 47 mm.; expanse, 83 mm.

Color dark brown to blackish, darker than in other species of the genus. Middorsal line on the disc of the prothorax obscure reddish yellow, narrow or more or less interrupted in the middle. Wing veins clouded with blackish brown. Prothorax wider than long, about as wide as the head. Straight margined on front and at sides but convex behind, angles sharp.

Male. Ninth ventral segment moderately produced rearward where broadly rounded and upcurving, covering more than the 10th sternite, an impressed fold each side as in *P. californica*. Tenth segment a narrow ring, divided on the dorsum into two erect narrow lobes. Supra-anal plate developed into an enormous horny sperm conveyor, the extreme of complexity, for this genus, more highly arching than in *P. californica*, its bifid tip more strongly

decurved, its sperm cup placed within an apical dilatation of the descending arm as in that species. Subanal plates broad.

Female. Eighth sternite produced in a broadly rounded lobe and bearing at midway the length of the segment two very large elongate-triangular processes that reach rearward beyond the middle of the 9th sternite.

Distribution.—Mission, British Columbia, down the west coast to Palm Springs, Southern California.

This species is somewhat earlier in season. Specimens from Shasta Springs, Calif., collected by T. E. Snyder bear date of June 23; and the species was found by the senior author in the height of its transformation at St. Andreas Canon, near Palm Springs, Calif., in April.

Pteronarcys proteus Newman.

(Plate 7, figs. 11, 12, and text fig. 2.)

1838. *Pteronarcys proteus* Newman, Ent. Mag., 5:177.

1873. *Pteronarcys proteus* Hagen, Proc. Bost. Soc. Nat. Hist., 15:283 (nymph).

1907. *Pteronarcys spinosa* Banks, Proc. Ent. Soc. Wash., 8:8.

1917. *Pteronarcys proteus* Smith, Trans. Amer. Ent. Soc., 43:452 (full bibliography of 9 titles).

Male. Length to wing tips 33 mm.; of antennae 17 mm.; of tails 7 mm.; expanse of wings 56 mm.

Female. Length to wing tips 40 mm.; of antennae 20 mm.; of tails 7 mm.; expanse 70 mm.

Color dark brown; frontal tubercles rufous. A narrow obscure rufous median line upon the disc of the prothorax. Venter varied with testaceous or obscure rufous, deepening on the abdomen.

Head a little narrower than the prothorax, the latter slightly widened posteriorly, sides and front border of disc straight, rear margin convex; angles square. Wings dusky.

Male. Ninth ventral segment moderately produced, not wholly covering the sternite of 10, upturned and evenly rounded in the rear. The ninth tergite bears a horny rounded projection that arises from its rear and is directed forward upon the apex of 8 middorsally and closely laid upon the tergum. Tenth segment almost covered by the 9th below, and bifid above in a pair of rounded lobes. Subanal plates spoonshaped together clasping between them the base of the supra-anal plate which is modified into slender erect, recurved, probe-like organ, utterly dif-

ferent in form and doubtless in function from that of the preceding species. No sperm cup present.

Female. Oval subgenital plate occupying half of the 8th sternite and bearing at its apex a pair of long spine-like processes that reach to the middle of the ninth sternite. These processes are closely approximated at the base, and after slight divergence, often again approximated at their tips.

Distribution.—Trenton Falls and Ithaca, N. Y.; Mass.; Vt.; Mackenzie River and N. Red River, Canada; California.

The male and female associated together by Newman in his original description of this species do not belong to the same species. This was proved by Miss Lucy W. Smith by the rearing of both sexes at Ithaca, N. Y. This mixup led to the description of the true female of *P. proteus* as *P. spinosa*. Nymphs abound in the spring fed brooks about Ithaca, though the adult is rarely collected.

Pteronarcys biloba Newman.

(Plate 7, figs. 9, 10.)

1838. *Pteronarcys biloba* Newman, Ent. Mag., 5:176.

1876. *Pteronarcys bicarinatus* Provancher, Nat. Canad., 8:190.

1917. *Pteronarcys biloba* Smith, Trans. Am. Ent. Soc. 43:453 (full bibliography of 9 titles).

Male. Length to wing tips 34 mm.; expanse of wings 55 mm.

Female. Length to wing tips 46 mm.; expanse of wings 84 mm.

Color dark brown above and below. A narrow rufous median line upon the prothorax; frontal cornicles rufous; legs dark brown, paler at the knees.

This is the handsomest species of the genus. In mature specimens the middle pale line on the pronotum is rather bright red, as is also the whole ventral surface of the body. The wings are marked by two clouds of fuscous, one extending obliquely outward from the wing base along the median cross veins, and the other extending transversely backward from the region of the stigma.

Male. Ninth ventral segment moderately produced, covering segment 10 below, up-curving to a broadly rounded and thickened rear margin. Segment 10 bifid above, a wide cleft separating the two rounded lobes. Subgenital plates spoonshaped together clasping the base of the supra-anal plate which forms, as in *P. proteus*, a slender erect and recurving chitinous probe-like organ.

Female. The entire 8th ventral segment is involved in the formation of a subgenital plate, by division of it deeply into two parts each of which is produced into a flat triangular arcuate flap that extends nearly across the 9th sternite.

Distribution.—Trenton Falls and Ithaca, N. Y.; Hudson Bay to Black Mts., N. C.

The period of flight as evidenced by our specimens ranges between late May, when specimens were collected at Sunburst, N. C., and late June, when a single male was taken on Mt. Moosilaukee, N. H., by Mr. N. S. Easton.

Pteronarcys comstocki Smith.

(Plate 7, fig. 13.)

1838. *Pteronarcys proteus* Newman, (female). Ent. Mag., 5:177.
1917. *Pteronarcys comstocki* Smith, Trans. Amer. Ent. Soc., 43:454.

Female. Length to wing tips 52 mm.; expanse, 70 mm.

Color brown; an obscure triangular median light spot on the anterior border of the prothorax. Venter of thorax paler and posterior margins of abdominal sternites 1 to 7 each bordered with a narrow pale band, the 8th, except at tip, and the 9th entirely of lighter color.

Head a little narrower than prothorax; the angles of the latter right angles.

Female. Subgenital plate arising near the middle of the 8th sternite broadly oval or rounded triangular, bearing, at its tip, two minute teeth bordering a minute inconspicuous apical notch.

Male unknown.

Distribution.—Trenton Falls and Wilmurt, and Tarbel (near Ithaca), N. Y. (Wm. T. Davis).

Genus PTERONARCELLA Banks.

1900. *Pteronarcella* Banks, Trans. Amer. Ent. Soc., 26:242.
1917. *Pteronarcella* Smith, Trans. Amer. Ent. Soc., 43:455.

Stoneflies of medium size, similar in form to Pteronarcys, but only half as large and having the same sort of reticulate venation. Crossveins of the wing fewer, entirely absent from the radial areas in the middle of the wing; median vein but two-branched. Color brown; a squarish black spot on the head covers the ocelli but leaves the large frontal tubercles pale. The quadrangular disk of the prothorax bears a median longitudinal pale line, which is generally continued on the front of the mesothorax. The ninth abdominal segment is elevated in a broad transverse recurved scoop-like lobe and some of

the segments in front of it bear paired dorsal humps at the sides. The large U-shaped supra-anal process is wholly concealed when at rest between the subanals and the divided halves of the tenth segment. We show it extruded in one of our figures. Its morphology was carefully worked out by Miss Lucy W. Smith in her Monograph (Trans. Amer. Ent. Soc., 43: 457, 1917). The genital plate of the female (eighth ventral abdominal segment) is chitinized in the middle portion only, and the form of its apical margin is of first importance in determining species. This is easily seen in fresh, or in well preserved alcoholic specimens; but it dries in a great variety of shapes in pinned specimens, and external appearances are not always to be trusted. It is often necessary to relax such specimens by boiling in order to make certain determination. There is a narrow inconspicuous band of prickly pubescence, more or less interrupted in the middle, extending across the ninth abdominal sternite on its apical margin.

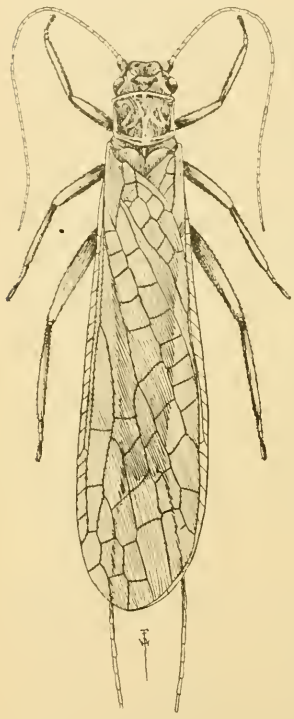

Fig. 11. *Pteronarcella badia* Hag.

After finding the male of *Pt. regularis* associated with females that agree with Hagen's type females, it seems apparent to us that the male referred by Miss Smith to *Pt. regularis* cannot be that species. After careful comparison of long series of specimens, both pinned and alcoholic, we believe hers to have been the unknown male of *Pt. badia;* and we believe that her *Pt. torosa* male was only another variant of the same. The differences stated in her key (Trans. Amer. Ent. Soc. 43:458) seem considerable, but they are all relative, and deal with very variable characters. Especially do the paired dorsolateral knobs on some of the abdominal segments seem definite structural characters, until one discovers that whether they appear or not on a given segment may be due to contraction in drying. The width of

the scoop that projects forward and upward from the dorsum of the ninth segment in the male is very variable, and in a series of specimens intergrades completely between the two forms that she figured and described. The three-lobed tip of the genital plate of the female in *Pt. triloba* appears to be but another variant in the shape of this part in this same variable species, *Pt. badia*. We are unable to distinguish by reliable characters more than the two original species that were described by Hagen in 1873.

These stoneflies are superficially similar to Perla in appearance but distinguishable at a glance from Perla and all its allies by the venation and by the greater length of the first segment of the tarsus. The species look alike and are only to be distinguished by careful microscopic examination of genital parts.

The nymph is distinguished from that of other genera by the presence of tufted gills on the ventral side of the *three* basal abdominal segments.

A western genus, common in mountain streams.

Genotype, *Pteronarcys regularis* Hagen.

Key to the Species of Pteronarcella.

Males.

1. Recurved, scoop-shaped appendage on the dorsum of the ninth abdominal segment, acutely pointed at the apex and its side margins straight, its posterior face lacking scurfy or prickly pubescence except along a narrow median area ---------- *regularis*

   Recurved scoop-shaped appendage on the dorsum of the ninth abdominal segment broadly rounded at the apex, more elevated, blunter, and its side margins sinuous, its posterior face rather uniformly covered with scurfy or prickly pubescence ---------- *badia*

Females.

1. The small strongly chitinized subgenital plate in the middle of the rear border of the eighth sternite is M-shaped on its hind margin, with distinct and acute median notch, its tips generally on a level with the sides of the segment ---------- *regularis*

This plate, rounded on its hind border, or truncate or more or less trilobate, or even slightly retuse, but never acutely notched in the middle; generally a little shorter than the segment is at sides _____*badia*

Pteronarcella regularis Hagen.

(Plate 7, fig. 15; plate 8, figs. 3, 4, 5.)

1873. *Pteronarcys regularis* Hagen, Bull. Geol. Surv. Colo., p. 573.
1900. *Pteronarcella regularis* Banks, Trans. Amer. Ent. Soc., 26:242.
1917. *Pteronarcella regularis* Smith, Trans. Amer. Ent. Soc., 43:459.

Male. Length to tip of wings 18 mm.; expanse 32 mm.; tails 9 mm.

Female. Length to tip of wings 23 mm.; expanse 41 mm.

General color dark brown, head and thorax almost black, abdomen reddish brown with a series of light colored knobs on the lateral margin.

Head about as broad as prothorax. Ocelli form an isosceles triangle, posterior ocelli a little closer to each other than to the eyes. The antero-lateral margins of the frons raised. A black area covers the ocellar triangle and extends over the entire clypeus except for two small light areas near the sides, nearly opposite the anterior ocellus; labrum brown; on each side of the ocellar triangle a crowned yellow tubercle; rear of head dark brown; on the inner margin of compound eyes a broad yellow band touching the round tubercles and connected by a narrow transverse band behind the ocellar triangle. Antennae brown, second segment about as wide as long; third segment half again as long as wide, fourth segment not longer than wide. Palpi brown with very short hairs, the segments each appearing multi-articulate due to numerous irregular chitinous half rings.

Prothorax dark brown, about half again as wide as long, sides straight and parallel, anterior and posterior margins evenly convex, front angles nearly square, hind angles rounded; the mid-dorsal yellow band is indistinct in the middle with rather bright yellow areas at the ends, and there is a very narrow yellow line laid on the mid-lateral margin. Disc covered with indefinite, dark, raised sculpturings.

Meso and metathorax black, except for a triangular lighter depressed area near the front margin of the mesothorax. Wings uniformly brownish, veins dark brown. Legs brown, knees blackish; femora at distal end with a

dark mark above; tibia with a dark mark at the proximal end; tarsi darker toward the tip.

Abdomen dark brown. Tails yellowish at base, darker toward tip, basal segments short; segments beyond the middle at least five times as long as wide.

Male. First segment of the abdomen above with a pale whitish spot on each side. The dorso-lateral posterior margins of segments two to nine with yellow rounded knobs, the size of the knobs gradually increasing posteriorly, and those on segment 6 to 9 quite hairy. Dorsal posterior border of segment 9 emarginate, the area between the knobs hollowed out scoop-like with an anteriorly produced heavily chitinized raised triangular projection. The entire hollowed area thickly covered with very short spines. The lateral posterior margin of segment nine straight, hind ventral margin rounded; the ventral portion of this segment is divided from the lateral areas by diagonal carinae. Segment ten and supra-anal process entirely covered by segment nine. Subanal plates yellowish, darker brown at the pointed end where bent upward and projecting forward, the tips a little outcurved and reaching a little beyond the posterior border of segment nine.

Female. The middle area of the eighth ventral segment black and a dark triangular mark on the postero-lateral angle, followed by similar paired marks on segment nine. The subgenital plate (chitinized middle portion of the eighth abdominal sternite) bears a small, distinct, acute notch on its hind margin, the latter being M-shaped. There are narrow blackish lines across the extreme apical ventral margin of some of the preceding segments.

Distribution.—Truckee, Nev.; Olympia, Wash., ♂ and ♀; Seattle, Wash.; Seven Mile Hill, Ore.; Wallowa Mts., Baker Co., Ore. July 4 (E. P. Van Duzee). We have seen no specimens from the Rocky Mountains that indubitably belong to this species; and we fear that earlier distribution records rest on incorrect determinations, growing out of the circumstance that males of the two original species described by Hagen have not hitherto been certainly known. Excellent specimens of both sexes of this species were received from Trevor Kincaid collected at Olympia, Wash., and the females agree well with Hagen's type (examined by both of us), and these Washington specimens we have made the basis of our description.

Pteronarcella badia Hagen.

(Plate 7, figs. 14, 16, 17; plate 8, figs. 1, 2, 6, 7.)

1873. *Pteronarcys badia* Hagen, Bull. Geol. Surv. Terr., p. 573.
1907. *Pteronarcella badia* Banks, Cat. Neur. Ins. U. S., p. 10.
1917. *Pteronarcella badia* Smith, Trans. Amer. Ent. Soc., 43:460.
1917. *Pteronarcella regularis* Smith, Trans. Amer. Ent. Soc., 43:459 (♂).
1917. *Pteronarcella torosa* Smith, Trans. Amer. Ent. Soc., 43:461 (♂ and nymph).
1917. *Pteronarcella triloba* Smith, Trans. Amer. Ent. Soc., 43:462 (♀).

Male. Length to wing tips 15 mm.; expanse 22-24 mm.; tails 6 mm.

Female. Length to wing tips 17-19 mm.; expanse 30-34 mm.

Color blackish, varying in depth with age, the black becoming more diffuse in old specimens. Head deep black between the ocelli, the paler area around the compound eyes confluent with the yellow of the frontal tubercles, the latter forming a sharp emargination in the black spot of the crown at each side of it. First joint of antennae, and the carinae adjacent to its base, blackish. The mid-dorsal pale line of the prothorax meets a transverse pale dash on the middle of both front and hind margins of the prothorax. In the better colored specimens a large V-mark is laid upon the middle of the segment, its arms opening forward and curving outward, its point resting on the pale mid-dorsal line. There is also a narrow, oblique pale dash in the smooth field of the disk at either side of the point of the V. The rugosities at either side of these pale marks on the disc are generally black, but occasionally they are yellowish or reddish. Pronotum of the mesothorax blackish, with a median dividing pale spot that is dilated at the front. Wings dusky, without pattern; membrane smoky, veins brown. Legs brown to black, darker on the longitudinal carinae. Abdomen and tails brownish, in varying depths of color, darker on the genitalia and along the sides.

Male. Genital segments very dark brown: paired knobs on abdominal segments 2 to 8, yellow internally, and covered with brown scurfy hairs externally, distinctly elevated only on segments 5 to 8. Tips of the genital hooks slenderer and more sharply pointed than in the preceding species. Also the recurved scoop-like appendage on the dorsum of segment 9, besides being broader and blunter than in *P. regularis*, seems in this species to run down in continuity of marginal fold with the apical carina of segment nine at its sides, whereas the side of

this appendage in *P. regularis* seems to spread out and become lost on the dorsum of that segment.

This scoop varies greatly in width in the specimens before us. The widest form was taken by Miss Smith for the then unknown male of *P. regularis* and the narrower form was taken for a distinct species named *P. torosa*.

Female. Genital plate blackish, a little more recurved within the apical area of the eighth sternite than in *P. regularis*, its edge usually falling a little short of the level of the apex of segment, its border typically smoothly rounded, but sometimes truncate, or even a little retuse, but never with an acute middle notch. Another variant in form was taken by Miss Smith to be a distinct species and named *P. triloba* (Pl. 7, fig. 16), but we have not been able to find any good line of demarcation for such a species.

Distribution.—Bridger Basin, Wyo.; Cache Valley, Ut., Logan River, Ut. (I. M. Hawley); Bozeman, Mont., June 18, and Bridger Mts., Mont., 5,000 ft., June 19 (R. A. Cooley); Provo, Ut. (E. C. VanDyke); Crane, Ariz., Apr. 27 (W. J. Chamberlain); Watertown Lakes, Alta., Canada, July 1 (J. McDunnough); Milton, Ore., Apr. 5; Hood River, Ore., Apr. 7 (J. C. Bridwell).

A considerable number of adults of both sexes taken together in Logan Canyon on July 12, 1922, by the senior author and preserved in alcohol, has enabled us to learn something of the variability of this species. These adults were of all ages: some were emerging from their nymphal skins on the leaf drifts at the edges of the stream and were still pale; some were mature and well colored; and others were old and black. They were found clinging low in the willows and on the weeds by the waterside, and, being indisposed toward flight by day, were picked with the fingers.

Family PERLIDAE.

This is a large family, containing many of the most familiar genera and species of stoneflies. The largest forms are members of the genera Acroneuria and Perla. A number of diurnal, foliage-inhabiting, greenish forms occur in the genera Alloperla, Chloroperla and Isoperla. All are stream-side dwellers but a few, whose nymphs have the most abundant development of gills, such as *Perlinella drymo* and *Perla capitata*, may be found about the stony borders of lakes and ponds.

Wingless forms are unknown, but brachyptrous males occur in one or more of our Western species (*Perla languida*). In all the terminal segments of the palpi and the

two basal segments of the tarsi tend to be reduced to small dimensions—characters that are distinctive of the family. The venation and the male genitalia have been rather fully discussed and illustrated in preceding pages of the Introduction.

Key to the Genera of Perlidae.

1. Head as long as wide, much longer than pronotum; compound eyes situated far forward on head so that the distance between the eyes and the front margin of pronotum is at least twice as great as the diameter of the eye—*Kathroperla*
   Head usually wider than long, not longer than pronotum; the distance between the eyes and front margin of pronotum usually less than diameter of the eyes 2

2. With two ocelli 3
   With three ocelli 5

3. Prothorax much wider than head; tails not longer than width of pronotum; no intercubital crossveins in hind wings; forewings with numerous heavy costal crossveins—*Peltoperla*
   Prothorax little, if any, wider than head; tails much longer than width of pronotum; intercubital crossveins mostly present in hind wings .. 4

4. Ocelli close together, usually on black spot; anal field of forewing without crossveins; costal crossveins present before end of Sc; ninth sternite of male without a hammer—*Neoperla*
   Ocelli two or more diameters apart (a trace of an anterior ocellus sometimes noticeable); anal field of forewing with one or more crossveins; no costal crossveins before end of Sc; ninth sternite of male with a transverse oval hammer ..... *Atoperla*

5. Anal area of forewing with a single row of crossveins; pronotum with a broad yellow or reddish longitudinal band each side of the median dark band ..... *Perlinella*
   Anal area of forewing without crossveins, except those that form the anal cell; markings of prothorax not as in *Perlinella* 6

6. Forewing with a branched vein from anal cell below; prothorax transversely oval i. e., angles usually much rounded; mostly small greenish species ---------- 7
Forewing with two simple veins from anal cell below; prothorax squarish i. e., angles rather well defined ---------- 9

7. Hind wing without folded anal area and no wider than the forewing; small greenish species (under 10 mm. in length) ----------*Chloroperla*
Hind wing with a folded anal area and wider than forewing ---------- 8

8. Greenish forms; Cu2 of forewing very short, separating from Cu1 about opposite the tip of 1st A and curving downward at a broad angle; R and M of forewing fused at base; hind wing without intercubital crossveins----------*Alloperla*
Not greenish; Cu2 of forewing longer and separating from Cu1 nearer the origin of 1st A; R and M of forewing not fused at base; hind wing with intercubital crossveins ----------*Paraperla*

9. Portion of wing beyond the cord is short and at the front of the radial sector there is a network of irregular crossveins ----------*Perlodes*
Portion of wing beyond the cord is longer and if crossveins are present, not so localized (except in Acroneuria they are few and regular) ----- 10

10. Radial sector with numerous branches that curve forward at tip. Tip of vein M curves backward; large species with ocelli very small and wide apart ----------*Isogenus*
Tips of branches of vein Rs and M less divergent 11

11. Hind wing without intercubital crossvein; mostly greenish species; male with an apical lobe beneath segment 8. Subgenital hooks slender, claw-like, and developed from the subanal lobes ----------*Isoperla*
Hind wing with several intercubital crossveins-- 12

12. Costal edge of wing yellow including base of Rs and M. In hind wing Rs and M fused basally more than half the length of the wing disc. Middle segments of tails 3 to 5 times as long as wide ----------*Perlesta*

Costal edge of wing not yellow (except in *Perla capitata*) : fusion of veins Rs and M in hind wing less extensive (except in *Cliloperla annecta*) ____ 13

13. Male with a percussion disc or hammer developed on the 9th abdominal sternite; large species with copious venation, and usually many crossveins in the portion of the wing beyond the cord; cubito-anal crossvein close to the apex of the anal cell _____*Acroneuria*

No percussion disc on the 9th sternite of the male (except in *Perla languida*) _____ 14

14. The 10th abdominal segment of the male cleft above; genital hooks when present developed from the apical angles of the cleft_____*Perla*

The 10th abdominal segment entire above; genital hooks when present developed from the subanal lobes _____*Cliloperla*

Genus PERLODES Banks.

1903. *Perlodes* Banks, Ent. News, 14:241.
1912. *Perlodes* Klapalek, Coll. Zool. de Selys, IV, 1:31.
1841. *Dictyopteryx* Pictet, Hist. Nat. Perlides, p. 147.
1917. *Perlodini* Smith, Trans. Amer. Ent. Soc., 43:463.

Rather large, dusky-winged stoneflies, having an area of irregular polygonal cells in the front portion of the wing tip beyond the well developed cord. Crossveins in the costal space tend to be reduced in number, and sometimes almost absent especially from the portion adjacent to the humeral crossvein. The first anal vein in the fore wing where it departs from the anal cell is bent forward to its junction with the cubitus, and then suddenly bent away again at a sharp angle. The basal fusion of veins Rs and M in the hind wing is short. There is a longitudinal middorsal pale line on the prothorax, that is often continued forward upon the rear of the head, ending in a yellow spot within the ocellar triangle and there is a pale M-mark across the frons before the ocelli. The basal segment of the tarsus is about twice as long as the second and a third as long as the third segment. Tails long and hairy. Ventral gill rudiments persist in about half the species in from one to five pairs, the foremost of which is found at the base of the labium.

Genital hooks are developed in the male from the rear portion of the divided tergum of the tenth abdominal segment. In a deep cleft between these the chitinous U-

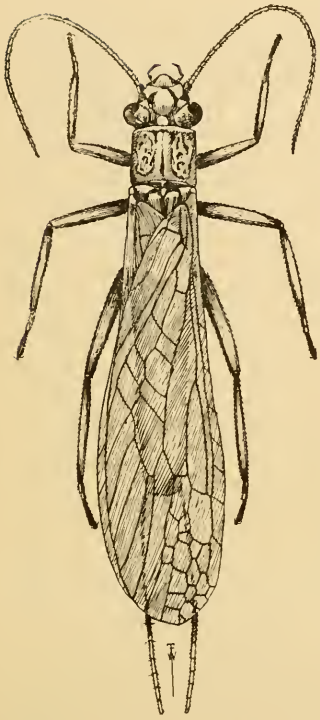

Fig. 12. *Perlodes signata* Hag.

shaped supra-anal process (similar in plan to that of Pteronarcella) lies more or less completely concealed. Backwardly directed processes, set in opposition to the genital hooks are developed in *D. vagans* on the dorsum of segment 7. A pair of slender stylets is attached to its sides near the bottom of the bend in the U. These characters cannot be seen without dissection; nor can the large penis, which lies concealed below these parts in the enlarged ventral portion of the 9th segment.

Short winged forms occur in the several species, and as usual, the wings are most abbreviated in the males.

Genotype, *Dictyopteryx microcephala* Pictet (European).

Key to the species of Perlodes.*

1. Costal crossveins in complete series ---------- 2
   Costal crossveins absent for a fourth or more of the distance from the humeral crossvein to the cord ---------- 4

2. Apical crossveins in cubital area numerous------ ---------- *dolobrata*
   Apical crossveins in cubital area few or wanting 3

3. Frontal tubercles more or less crescentic---*tibialis*
   Frontal tubercles round ----------*bradleyi*

4. Base of the radial sector joins vein R1 by a rounded curve ---------- 4
   Base of the radial sector straight, meeting vein R1 at a very acute angle ---------- 5

*P. minor Klp., from Arctic America, unknown to us, omitted.

5. Costal crossveins before the cord 7 to 8_____ _____ *irregularis*
   Costal crossveins before the cord 2 to 6___*signata*
   Costal crossveins before the cord 0 to 1 (brachypterous) _____ *yosemite*
6. Tip of subcosta runs out into costa_____*vagans*
   Tip of subcosta downcurved to join vein R1_____ 6
7. Apex of fore wing obtuse, semicircular in outline _____ *aurea*
   Apex of fore wing more pointed_____ 7
8. Vein Sc2 joins vein R1 generally much before the cord _____ *americana*
   Vein Sc2 joins vein R1 at or beyond the cord____ 8
9. Western species _____*ignotus*
   Eastern species _____ 9
10. Prothorax hardly longer than wide_____*lineata*
    Prothorax twice as long as wide_____*slossonae*

Perlodes dolobrata Smith.

(Plate 9, figs. 1, 6.)

1917. *Protarcys dolabrata* Smith, Trans. Amer. Ent. Soc., 43:469 (female).

Expanse of wing, male 33 mm.; female 44 mm.

Coloration brownish, darker on the thorax than on the top of the head. The pale M-line across the front is bordered before and behind with brown. The pale spot on the crown is small, occupying half the space between the ocelli. The round frontal tubercles are set in pale areas, but their summits are capped with fine brown marmorate embossed markings. Similar fine markings cover the pale post-ocular areas at either side of the vertex. There is a narrow line of yellow behind the brown across the occiput and the hind angles of the head are brown.

The mid-dorsal pale line of the prothorax is obscure in the middle, hardly more than the middle groove being there yellow; but the yellow is extended laterally on front and hind borders. The brown rugosities of the sides of the disc of the prothorax are coarse and rather conspicuous. The width of the prothorax is one-half greater than its length, and its sides are convergent to rearward. Front angles rather acute; collar rather wide. Middle pale line on meso- and metathorax very obscure. Femora brown dorsally, except for a narrow pale line capping the knee. Basal seventh of tibiae brown externally, the remainder pale. Wings smoky hyaline, with veins somewhat infuscated, especially at the stigma.

Abdomen brown, paler beneath. Tails yellow, very hairy on the short basal segments.

Male. Abdominal segments normal to the 9th; this segment has a pair of minute triangular teeth beside the mid-dorsal line on its apical margin; on the ventral side is a broad scoop-like semicircular projection that extends its length by a third; this subgenital projection is set off by a short sulcus or fold at each side. Segment ten is divided as usual for the accommodation of the huge U-shaped supra-anal process. A blackish six-rayed figure on the dorsal side marks the attachment of the base of this process. Each side of ten is deeply cleft above into a wide semicircular notch, surrounded by two slender incurving strips of chitin. The upstanding tip of the supra-anal process is linear blunt and cylindric and the two small lateral processes at its side are thorn-like.

Female. The subgenital plate is produced backward in a long evenly rounded lobe that covers the 9th sternite and overlaps upon the tenth.

Distribution.—For type, unknown; for male neallotype (described herewith), Glacier Peak and Lake Chelan District, Aug., 1921 (Ruth F. Bottomley).

Perlodes bradleyi Smith.

(Plate 9, figs. 4, 5; plate 10, fig. 4.)

1917. *Protarcys bradleyi* Smith, Trans. Am. Ent. Soc., 43:470.

Male. Length to tip of wings 20 mm.; expanse 32 mm.

Female. Length to tip of wings 23 mm.; expanse 37 mm.

Color. Brown varied with yellowish. Prothorax somewhat darker than the rear. The transverse M-mark in front of ocelli is connected at its middle with an inverted V-mark whose arms join and include the ocelli; in front of it an obscure median pale line and two lateral roundish spots on the clypens. An inverted T-mark covers the rear of the head, its wide stem, conspicuously yellow, is conjoined basally and confluent with the very small crown spot between the ocelli (no such spot present in one specimen) and joined also with narrow laterally divergent pale lines that mark the frontal suture, and its narrow arms extended across the occipital border of the head, are a little dilated the ends into obscure post-ocular pale areas. These areas are more or less besprinkled with fine brownish marmorations. Antennae yellowish brown, palpi, pale yellow.

The prothorax is brown-bordered except for a yellow spot on the middle at the front and another at the rear. These spots are connected by the usual pale line, which in this species is rather narrow and obscure. Embossed markings at sides of the disc rather coarse. The prothorax in shape is quadrangular, little wider than long and scarcely narrower to rearward. Legs yellowish with a wash of pale brownish on both ends of the femora (except at knees) and tibiae and tarsi externally. Wings smoky hyaline with the veins brown, the basal ones a little infuscated. Abdomen brown above, paler beneath; tails yellowish with rings of brown on apices of the segments.

Male. Abdominal segments normal as far as the ninth which is moderately elongated beneath, being twice as long on the ventral as on the dorsal side, its sternum scarcely prolonged into a genital scoop that is set off at each side by a very shallow notch or fold. On the dorsal side there is a narrow, strongly chitinized tranverse ridge across the declined and sloping apex of the tergum. The tenth segment is cleft longitudinally on the dorsum to accommodate a large U-shaped retractile supra-anal process (invisible except on dissection), and the upper end of each half is emarginate in the middle, rounded on the proximal angle, while the distal superior angle is produced into a short, sharp, thorn-like spine. The two spines are directed somewhat forward, and constitute incipient genital hooks.

Female. The subgenital plate is prolonged backward into a single broadly rounded lobe, reaching halfway across the sternum of the ninth segment.

Distribution.—Canadian Rockies; Selkirk Mountains, B. C., J. C. Bradley. Kaslo, B. C., June 2, H. G. Dyar.

Perlodes tibialis Banks.

1914. *Perlodes tibialis* Banks, Proc. Ac. Nat. Sci., Phila., p. 608.

Male. Length to tip of wing 25 mm.; expanse 40 mm.

We have not had for dissection any specimens that seem referable to this species, but the junior author has had the privilege of examining the type (a male) in the Museum of Comparative Zoology at Cambridge, Mass., and it seems to differ from the preceding species by the following characters:

1. It is larger in size, 40 mm. in expanse of wing as compared with 32 mm. in *P. bradleyi.*

2. Its palpi are dark brown, not pale yellow.

3. Its pale crown spot between the ocelli is larger and not confluent with the yellow of the rear of the head.

4. Its femora are blackish (except knee ring), not pale brown.

5. Its prothorax is clothed with yellowish hairs.

Female unknown.

Distribution.—Olympic Mountains, Washington.

The shrivelled condition of the end of the abdomen prevented a critical study of the male genitalia of the type. The venation is quite like that of *P. dolobrata*, and the sides of the prothorax are similarly convergent to rearward. Abundant crossveins in the cubital area of the tip of the forewing seem to ally this species with *P. dolabrata* rather than with *P. bradleyi*.

Perlodes signata Hagen.

(Plate 9, figs. 7, 8; plate 4, figs. 6 to 10; plate 10, fig. 3.)

1873. *Dictyopteryx signata* Hagen, Bull. Geol. Surv. Terr., p. 575.
1903. *Perlodes signata* Banks, Ent. News, 14:241.
1912. *Megarcys signata* Klp., Coll. Zool. Selys, 4:12.
1917. *Megarcys signata* Smith, Trans. Am. Ent. Soc., 43:472.

Male. Length to tip of wings 20 mm. Expanse 30 mm.

Female. Length to tip of wings 25 mm. Expanse 42 mm.

Color brownish, varied with yellow. Sides of head and thorax darker than the dorsum. Middorsal pale stripe rather conspicuous. Transverse pale M-line across the frons inconspicuous. Another M-line in brown subtends it in the rear, enveloping the front ocellus and running rearward in a pair of diverging lines to the posterior ocelli, and thus surrounding the pale spot on the crown. There is a roundish median occipital spot of yellow, often connected by a narrow median line with the crown spot, bordered on either side by an anvil-shaped spot of brown whose long point extends obliquely forward along the frontal suture. Eyes surrounded by yellow internally, and followed by a brown spot that covers the hind angles of the head. In pale specimens these markings are often very obscure. Antennae and palpi yellowish brown.

Prothorax quadrangular, a little wider than long, a little narrower than the head. Middorsal stripe yellow, broad, slightly widened posteriorly and often divided by a narrow median single or broken or double or otherwise irregular line of pale brown. Brown raised marmorations thickly besprinkle the sides of the disk, closely crowded

up to the edge of the middle stripe, more openly spaced toward the yellow line at the side margin. Similar smaller marmorations besprinkle the large yellow areas upon the sides of the occiput. There is a short narrow pale stripe on the praescutum of the mesothorax, and a still paler spot before each wing root. Legs pale with a wash of brown near the ends of femora and tibiae and tip of tarsi; knee yellowish, between the bands of brown. Wings smoky hyaline with brown veins, abdomen brownish, darker on the sides.

Male. Segments normal to the 9th abdominal, which is twice as long on the ventral as on the dorsal side, its sternite prolonged rearward in a broad genital scoop with a short longitudinal fold or sulcus demarking its sides. Middorsal margin slightly elevated, reflexed, and thickened and beset with short stiff yellowish hairs. The 10th segment is divided on the middorsal line to accommodate the remarkably enlarged supra-anal process; the top of each half is again divided transversely by a deep oval cleft, the edges of which are fringed with stiff yellowish hair; the shorter anterior division before the cleft is normally concealed within the apex of the 9th segment; the longer posterior division is curved forward and, with its fellow of the opposite side, constitutes the genital hooks.

Female. The subgenital plate is prolonged to cover the ventral surface of the 9th segment, divided into two broad, evenly rounded lobes, between which is a narrow, parallel-sided square-cut notch; its bottom is at the level of the apex of the 8th segment.

This is the common species of our western mountains. In the original description Hagen (l. c. p. 576) called attention to the five pairs of gills that the adult insect carries over from the last nymphal stage.

Distribution.—Colorado, foothills; Tolland, Colo. (G. S. Dodds); Kenosha Pass, August and Platte Canon, Colo., July (Osler); Lawn Lake, Estes Park, Colo. (P. W. Claassen); Custer Co., Colo. "A 25" brachypterous male (T. D. A. Cockerell); Salt Lake Co., Utah, June 10, 1910; Rogers Pass, B. C., 4500 ft. to 5525 ft. elevation, males and females, August 19, 1908 (J. C. Bradley); Howser, Selkirk Mts., B. C., June 22 (J. C. Bradley).

Perlodes yosemite new species.

(Plate 7, fig. 20; plate 10, fig. 8.)

Male. Length of body 13 mm.; of antennae 11 mm.; of tail 10 mm.

Female. Length of body 15 mm.; of antennae 11 mm.; of tail 10mm.

A long horned, long tailed, long legged, short winged species of dirty olivaceous-fuscous color obscurely varied with pale, the middorsal stripe and the crown spot on the head being the more conspicuous marks. The color pattern is best developed in the female specimen and is as follows: head brownish, paler on the labrum, on the margins of the clypeus, on the crown spot between the ocelli, on the extreme occiput, and on two large post-ocular spots extending from the eyes to the hind angles of the head; the latter are brown at the sides. The M-mark across the frons is not very plain and is somewhat abnormal, the portion adjacent to the middle ocellus being swollen and enlarged, and the ends of the M relatively small. Antennae fuscous, paler at base of flagellum.

Prothorax, squarish with a wide collar at the front, straight parallel sides, and a deep middle sulcus in the midst of a broad pale middorsal stripe that widens strongly at its ends. Embossed markings on sides of disc few, coarse, and irregular. Middle stripe continued on mesothorax but obscure there. Wings dull smoky brown, with a darker wash across the base in a faint streak at front and rear. Wing tips reach the level of the tip of the abdomen in the female and are a very little shorter in the male. Veins brown. Legs olivaceous, with rather plain washes of brown in rings on femora and tibiae adjacent to the pale knees. Tails, olivaceous at base, becoming darker at tip. Abdomen black, paler at tip on segments 9 and 10.

Male. Similar to *P. signata* but with a narrower transverse cleft in the dorsal edges of the split tenth segment, and the genital hook at its rear is pointed, and not broadly rounded on its tip.

Female. Subgenital plate a broad bifid scoop extending across the 9th sternite, inflated in the middle, its thin cleft tip with approximated obtuse points appressed against the 9th sternite. Pale, except for two basal brown marks at the side, which are repeated on the sides of the 9th and 10th sternites.

This species is similar to *P. signata* but smaller and more plainly colored, and its rear ocelli are farther apart, being closer to the eyes than to each other.

Distribution.—A single pair, male holotype, female allotype, from Mt. Lyell, Calif., taken at an altitude of 11,000

ft. by J. R. Selvin and now in the collection of the California Academy of Sciences.

Perlodes irregularis Banks.

(Plate 7, fig. 24; plate 10, fig. 7.)

1900. *Dictyoptryx irregularis* Banks, Trans. Amer. Ent. Soc., 26:243.
1907. *Perlodes irregularis* Banks, Can. Ent., 39:327.
1912. *Megarcys irregularis* Klp., Coll. Zool. Selys, 4:12.
1917. *Megarcys signata* Smith, Trans. Amer. Ent. Soc., 43:472.

Male. Length to wing tips 20 mm.; expanse 32 mm.

Female. Length to wing tips 28 mm.; expanse 48 mm.

Color brown, varied with yellow. Top of head with two irregular black bands that converge toward the occiput, surround a conspicuous yellow crown spot, meet at the middle ocellus and diverge again along the middle parting of the obscure yellow M-line that crosses the frons. Outside the brown a yellow band on each side extends forward from the occiput surrounds the eye dorsally, covers the oval frontal tubercle, and follows the outer leg of the M-mark down on the sides of the clypeus. Behind the eyes the hind angles of the head are blackish; dorsal half of basal segment of antennae blackish; ventral half yellow, remainder obscure, darkening beyond the third segment to the apex, palpi obscure. Prothorax squarish with convex front and hind margins set off by transverse grooves and with a rather deep middle sulcus. Mid dorsal line of yellow, broad and conspicuous, widened at the ends. Embossed markings at sides of disc marmorate black. A fuscous background, vermiculate, but few of the markings in the outer fourth of the area. Wings fuscous with brown veins, faintly cloudy on the crossveins of arculus and cord. Legs yellow, conspicuously marked with fucous as follows: the dorsal sixth of the tibiae, a subapical wing on femora that runs proximally in two vanishing streaks, and one or two marks across the base of the femora on the dorsal side.

Abdomen tawny fuscous, the color deepening toward the apex, venter paler with three dots in a row across each of the middle segments; the ninth segment blackish except on its projecting rear margins above and below.

Male. Segments normal to the ninth, that segment abbreviated dorsally and bearing just before the hind margin a conspicuous bilobed transverse reddish crest, sides oblique, and vents prolonged into a broad scoop-like subgenital plate, upcurved on their margin and pale reddish or yellowish in color. This extension of the sternite

adds a fourth to the length of the segment, and is set off at either side by a fold half the length of the segment. Segment ten divided middorsally as usual. The upper edges of its side walls, deeply cleft and the hind angle prolonged and curved forward in a very long ensiform pointed genital hook, that is obliquely truncated at its tip, not rounded as in *P. signata*.

Female. The broad subgenital plate is produced to cover half the ninth sternite and is divided into two broadly rounded lobes that are separated by a shallow acute notch.

Egg. The egg of this species is oblong with ends symmetrically rounded. It is one-half wider than long. The brownish shell is marked off in rather regular hexagons, made of flat raised anastomosing ridges that are half as wide as the areolations they inclose. There is a small collar-like rim at the micropylar end, through which projects a transparent stalk: no cap seen upon this stalk in the specimens that have been before us.

Distribution.—Mount Rainier, Wash. (female type); male neallotype herewith described from same; Paradise Valley, collected by E. P. Van Duzee July 17, 1920); Waterton Lakes, Alta. (J. McDunnough).

Perlodes slossonae Banks.

(Plate 7, fig. 19.)

1914. *Perlodes slossonae* Banks, Proc. Ac. Nat. Sci. Phila., p. 608.
1917. *Arcynopteryx inornata* Smith, Trans. Amer. Ent. Soc., 43:481.

Length to tip of wings, 17 to 18 mm.; expanse, 30 mm.

Color brownish, the meso and metathorax blackish. Head concolorous above, in so much that the usual frontal tubercles and transverse M-line are scarcely visible. Ocelli rather small, the rear ones about as close to the eyes as to each other. Antennae and palpi dark brown.

Prothorax chocolate brown with a broad yellow median stripe that connects with the yellows on the rear of the head. Disc a little wider than long, its sides rather strongly rugose. Front angles sharp; hind angles rounded. No gills. Legs brown. Wings with a scanty and irregular network of crossveins in the tip between the costa and the branches of R2. First half of costal area beyond the humeral free from crossveins.

Abdomen blackish above, brownish beneath and lighter toward the tip. Tails yellow at base, darkening toward the tip; the segments darkening distally and clad with lacy hairs.

Female. Subgenital plate bilobed with hairy margin, the lobes extend well over the ninth sternite, and the median excavation between them is wide.

Distribution.—White Mountains, N. H.

The type is No. 11308, M. C. Z., in the Banks Collection.

The junior author has studied this type and finds Banks' figure of the subgenital plate seriously in error (l. c., Pl. 28, fig. 17), in showing the lobes at its tip slender and incurved; they are broad and rounded, as shown in Miss Smith's plate (l. c., Pl. 33, fig. 53), and in our figure.

Perlodes lineata Smith.

(Plate 7, fig. 18.)

1917. *Arcynopteryx lineata* Smith, Trans. Amer. Ent. Soc., 43:476.

Below we transcribe the entirely adequate original description:

Female. Length to tip of wings, 22 mm.; expanse of wings, 34 mm.; length of antennae, 9 mm.; length of setae, 11 mm.

Color dark brown varied with yellow, pubescent. Head with three small ocelli arranged in an isosceles triangle, the lateral ocelli equidistant from each other and the inner margin of the eyes, the distance between them a third greater than the side of the triangle. On either side of the ocellar triangle, a little closer to the lateral ocellus than to the inner margin of the eyes, is a rather flat, elliptical tubercle. M-shaped mark fairly prominent. Head yellowish-brown, a blackish-brown, rectangular, frontal spot with short horns extending posteriorly to the paired ocelli; entire occipital border yellow with a broad, median, triangular extension passing forward with its apex in the apex of the ocellar triangle; anterior to the yellow border, a dark brown coarsely sculptured oval area on the lateral occipital regions. Under side of head yellowish, palpi and antennae brown.

Prothorax quadrangular, wider than the occiput, breadth almost twice as great as the width, front and hind margins a little convex, sides straight, angles rounded; a broad, median, yellow stripe; inner lateral fields with glossy corrugations. Meso- and metanotum dark brown. Venter of thorax pale with a large, brown, median, shield-shaped spot on each of the three segments, on the anterior border of the last two segments, transverse bands running out from the median spots. Legs dark brown with femora and upper part of tibiae a little paler in coloration. Wings with yellow-brown venation, an ir-

regular network of crossveins between costa and the branches of the radial sector; nearly the first half of the costal area beyond the humeral crossvein free from crossveins; the length of the inner inter-radial cell three times as great as its base. A single pair of small, white, fleshy, finger-like gills on the lateral margins of the submentum.

Female. Abdomen uniformly dark brown; basal segments of the setae brown, the following ones alternately ringed with white and brown, each segment being marked with a narrow, basal, ring of white followed by first a narrow brown, then a narrow white band and finally a broad, brown, terminal ring. Subgenital plate trapezoidal with a broad, shallow, V-shaped, apical notch (fig. 48).

Distribution.—Old Forge, N. Y. (the female type), Aug. 16, 1905. (J. G. N.)

Perlodes americana Klapalek.

(Plate 7, fig. 21; plate 10, fig. 5.)

1912. *Arcynopteryx americana* Klp., Coll. Zool. Selys., 4:21.
1917. *Arcynopteryx americana* Smith, Trans. Amer. Ent. Soc., 43:481.

Expanse of wings, male 24 mm.; female 37 mm.

Color black, lineate with yellow. A broad longitudinal mid-dorsal stripe begins between the ocelli and extends along head and prothorax and ends in a triangle on the praescutum of the mesothorax. Sometimes it is followed by a narrow linear dash on the top of the metathorax. Hind angles of the head behind the eyes yellow, this being confluent around the occiput with the middorsal stripe. Frontal tubercles low, ovoid in outline, more or less yellow, in areas of solid black. The M-line on the frons is dilated at its ends to cover the flaring lateral margins of the clypeus. Antennae and palpi blackish. Legs obscure brownish or translucent olivaceous, indistinctly darkened toward the knees. Abdomen blackish, paler beneath. Tails long, hairy, the segments darkened in color toward their tips.

Male. The apical carinae of abdominal segments 4 to 8 tend to become swollen and padlike rather than carinate, and are covered with scurfy hairs on the dorso-lateral angles. They are most thickened on segment 7. Segment 9 is narrower and generally pale, very much widened ventrally, the sternum is suddenly prolonged backward into a wide ovoid subgenital scoop half as long as the portion of the segment before it. There is a depressed area in the middle of the tergum of segment 9, and a bare callosity

at its bottom. Segment 10 is cleft above for the reception of the retractile U-shaped supra-anal process, and the rear angle beside the cleft each side is prolonged into a finger-like lobe that is bent forward to form a genital hook. The U-shaped supra-anal process is slightly constricted below an ovoid summit, and its stylets have sharp thorn-like tips.

Female. Subgenital plate broad, set off at sides by folds evenly truncate across its wide apex and more strongly chitinized on its lateral angles. The appearance of this plate is exceedingly variable in pinned specimens, since the middle portion of the hind margin is thin and may be variously in- or out-rolled in drying. It is nearly always more strongly chitinized at the sides next to the marginal folds.

Distribution.—Colorado; Boulder, Colo., Apr. 4 and Apr. 6, 1904 (S. A. Rohwer); "Fallen Log," June 19, 1916 (A. C. Browne); Logan, Utah, Apr. 30, 2 females and 2 brachypterous males; Tenas L., B. C., Apr. 1904; Fair Oaks, Calif., May 10, 1918; Lewis Lake, B. C., May, 1904; (Stanford University Collection); Bozeman, Mont., May 10 (R. A. Cooley).

Perlodes aurea Smith.

(Plate 7, fig. 23.)

1917. *Arcynopteryx aurea* Smith, Trans. Amer. Ent. Soc., 43:477.

We have nothing to add to the original careful description, which is copied herewith:

Female. Length to tip of wings, 21 mm.; expanse of wings, 32 mm.

This species is apparently rather closely related to *Arcynopteryx vagans.*

Color: It is yellowish-brown with yellow markings. Head triangular, three small ocelli arranged in an isosceles triangle the base of which is greater than the sides, the distance from the inner margin of the eyes to the posterior ocelli less than the distance between the posterior ocelli, but greater than that from them to the anterior ocellus. Outside the ocellar triangle, conspicuous, dark brown tubercles situated a little nearer the paired ocelli than the inner margin of the eyes. M-shaped mark prominent. The anterior region of the head uniform yellowish brown, the occiput with three pale yellow spots, a small median triangular one with larger oval ones on either side. Under side of head pale, palpi brown.

Pronotum quadrangular, wider than the occiput and a little wider than long, only slightly narrowed posteriorly; sides straight, anterior border markedly convex, posterior one a trifle arcuated, anterior angles rather sharp, posterior ones rounded; a broad median yellow stripe, lateral fields embossed. A similar, broad median stripe on the metanotum, and a small median marginal spot on the anterior border of the metanotum. Venter of thorax pale with a median shield-shaped darker marking on each of the three segments; from these dark median spots on the last two segments, transverse extensions run out laterally just anterior to the base of the legs. Legs yellowish-brown, bases and tips of femora and tibiae, and tarsi, dark brown. Tips of wings broadly rounded, venation pale brown; a rich irregular network of crossveins between costa and the anterior branches of the sector, in the fore-wing there is not a long costal area beyond the humeral crossvein that is free from crossveins, subcosta passes into radius slightly beyond the level of the cord, the length of the inner inter-radial cell twice as great as its base, first anal vein forked (Pl. 7, fig. 23).

Female. Abdomen brown above and below; subgenital plate paler, large and shining, produced nearly across segment nine; the posterior border in the form of a W with rounded angles (fig. 49).

Distribution.—California; the single known specimen (female type) is without more specific designation of locality.

Perlodes ignota Smith.

(Plate 7, fig. 22.)

1917. *Arcynopteryx ignota* Smith, Trans. Amer. Ent. Soc., 43:479.

The following is the original description:

Female. Length to tip of wings, 17 mm.; expanse of wings, 29 mm.

Dark brown, with a few paler markings. Head triangularly produced; three moderately large ocelli arranged in an isosceles triangle, the base of which is greater than the sides, but less than the distance from the posterior ocelli to the inner margin of the eyes; the M-shaped mark present but not prominent, small, round, inconspicuous tubercles situated nearer the posterior ocelli than the inner margin of the eyes. The lateral borders of the clypeus pale yellow; a dark fuscous crown spot in the form of a letter X with its center in the median ocellus, the anterior part outlining the middle region of the M and the posterior part extending back to the lateral ocelli; a

median, deep yellow, occipital spot reaching forward between the ocelli; dark brown, coarsely sculptured, oval-shaped spots on the lateral occipital areas. Antennae brown, the basal segment the darkest; under side of head pale, palpi dark brown.

Pronotum rectangular, not as broad as the head; sides straight, front and hind margins convex, angles blunt; a yellow median band, broader behind; the inner regions of the lateral fields with embossed markings. Meso- and metanotum and the entire venter of the thorax, with the exception of narrow areas surrounding the bases of the legs which are paler dark brown. Legs brown except a pale band before the knees and pale tibiae. Wings with yellow-brown venation, except basal portions of costa and sub-costa in fore-wing and all bases in hind wing which are yellow; an irregular network of cross-veins extending from costa through the anterior branches of the sector, the network richest between veins R1 and R2, more than the first half of the costal area beyond the humeral crossvein free from crossveins; the length of the inner inter-radial cell twice as great as its base. Without gills.

Female. Abdomen uniformly dark brown, setae long and slender; alternately ringed with dark brown and white, except for the first few basal segments, which have but a single ring of dark and light, each segment is marked with a white basal band followed first by a narrow brown, then a narrow white ring, and finally a broad brown one. The eighth ventral segment produced somewhat triangularly with a rectangular notch in the tip. Subanal plates, large, triangular (fig. 52).

Distribution.—Described from a single female without locality record.

Perlodes minor Klapalek.

1912. *Arcynopteryx minor* Klp., Coll. Zool. Selys, 4:22.
1917. *Arcynopteryx minor* Smith, Tran. Amer. Ent. Soc., 43:483.

This species being unknown to us, as it was to Miss Smith, we copy here her translation of the original description:

Male. Length of body, 11 mm.; female, 13 mm.; length of anterior wing of female, 14 mm.

Anterior part of the body almost black, abdomen blackish brown, in the female yellowish spots on the venter. In the male the small crown spot of the head joins the occipital bands and widens laterally along the crown suture; the sides of the clypeus are yellow-brown. In the male the

middle band of the pronotum occupies the entire middle field; in the female it is less conspicuous, but the lateral portions show light areas. The under side of the head is yellow-brown with a black-brown throat; otherwise the under side is black-brown, the venter of the female is lighter. Antennae black-brown, palpi dark brown. Legs dark brown, femora narrowly bordered with yellow-brown on the ventral edge, and broadly on the dorsal; tibiae yellow-brown for the most part. Setae shining bright brown.

Head not as long as usual in the species of this genus and a little narrowed anteriorly. Eyes moderately large and spherically rounded, behind them there are short tempora. Ocelli small, forming an isosceles triangle; the distance between the posterior ocelli is more than half longer than the distance from the inner margin of the eyes and from the anterior ocellus (30:20:22). The crown suture distinct, the occipital furrow deep. Tubercles large, broadly oval, equally distant from the posterior ocelli and the inner margin of the eyes. The cuticle is fine, but with prominent reticulate wrinkles, and outside the tubercles and the M-shaped mark it is studded with scattered pits bearing bristles.

Pronotum slightly trapezoidal, narrower in front than the occiput, a little widened posteriorly (50:53:47). Anterior and posterior borders broad, convex; sides straight. Middle furrow narrow but deep; the middle area very broad, occupying in the first third almost a fifth of the entire breadth, widened anteriorly and posteriorly. The structure is similar to that of the head.

In the male the wings are greatly shortened, so that the anterior ones reach the posterior border of the second segment, and the posterior ones the posterior border of the third segment. In both sexes they are conspicuously smoked. The network in the tip of the wing occupies the space between radius, its sector, and the several branches of the same; but it is comparatively simple and composed of large, not very irregular cells. The inner inter-radial cell of the fore wing is a little more than once and a half as long as its base.

In the male the ninth segment is prolonged into a yellow-brown, parabolic, subgenital plate, the tenth segment is cleft on the dorsal side with mallet-like processes. The other parts show no departure from the usual form.

The female subgenital plate is short, semicircular, bright brown, and does not appear notched on the posterior margin.

Distribution.—Arctic America.

A pair in the collection of the Museum of London.

Perlodes vagans Smith.

(Plate 10, figs. 2, 9.)

1917. *Arcynopteryx vagans* Smith, Trans. Amer. Ent. Soc., 43:478.

Having nothing to add to Miss Smith's account of this species we copy her original description herewith:

Male. Long-winged. Length to tip of wings, 16 mm.; expanse of wings, 26 mm. Short-winged. Length to tip of wings, 14 mm.; expanse of wings, 21 mm.

Color: Yellowish-brown varied with yellow markings on the head and thorax, and paler beneath. Head triangularly produced; three small ocelli placed in an isosceles triangle, its base greater than the sides, the distance from the inner margin of the eye to the posterior ocellus greater than the side of the triangle, but not as great as the base. On either side of the ocellar triangle, a glossy, dark brown, oval tubercle, somewhat nearer the posterior ocellus than the inner margin of the eye. M-shaped mark conspicuous. Labrum whitish. From the tubercle a broad, dark fuscous area extending laterally to the eye and encircling its inner margin with a narrow band which spreads out posteriorly, covering the entire occipital region behind the eye, anteriorly the band broadens and runs along the lateral border of the frons and clypeus. In one specimen at the level of the anterior ocellus, a transverse bar connecting the dark areas of either side, in the same specimen, from the tubercle a posterior extension, running slightly diagonally inward to the occipital margin. Three pale yellow, coarsely corrugated spots on the posterior border of the occiput, a small median triangular one with its apex directed forward, and on either side close to the dark fuscous areas behind the eyes, a large oval spot. Antennae brown, stout, as long as the body; palpi brown; under side of head, pale.

Pronotum trapezoidal, anterior border wider than the posterior and wider than the occiput, sides and posterior margin straight, anterior margin convex, front angles rather sharp, hind angles rounded off; a broad, median, yellow stripe, conspicuous, glossy brown, embossed markings on the lateral fields. Meso- and metanotum dark brown with the median yellow band of the pronotum continued upon them. The entire venter of the prothorax pale with darker markings. Legs yellowish-brown; bases and tips of femora and tibiae and tip of tarsi, ringed

with dark brown. Wings with fine yellowish-brown venation, an irregular network of crossveins occupying the tip of the wing in the region between radius and the anterior branches of the sector; a little less than the first half of the costal area beyond the humeral crossvein free from crossveins.

Both long and short winged males; in the latter the wings are not greatly shortened, they extend to the tip of the abdomen. Five pairs of long, white, slender, fleshy finger-like, tracheal gills arranged as follows: one pair widely separated on the base of the submentum, a second pair on a line with the first in the articulation between head and thorax, the third pair a little lateral and anterior to the base of the fore legs, the fourth pair on the anterior border of the mesothorax on a line with the base of the legs, and the last pair in the same relative position on the metathorax.

Male. Abdomen dark brown above and on the sides, pale on the venter. Setae about three-fourths the length of the body; pale brown, conspicuously ringed with darker and provided with whorls of fine bristle-like hairs toward the tip of the segments. The seventh dorsal segment triangularly produced over the eighth, and ending in a strong, upright, median fork; the eighth segment normal; the ninth entire, narrow above, elongated below into a conspicuous subgenital plate marked with fine transverse striae, a median villous area set off from the lateral parts by prominent carinae. The tenth segment concealed by the ninth on the venter; widely cleft above, each lobe with an erect appendage-like process on the inner posterior margin; subanal plates boat-shaped, flaring; stylets entirely concealed by the para-genitals which appear between the posterior border of the tenth tergite and the subanals, as a pair of lateral chitinous sheaths with a white, membranous median portion (fig. 51).

Distribution.—Nevada County, Calif.; San Diego, Calif. April 23, 1879 (C. V. Riley).

This species is very distinct from other known members of the genus by reason of the pair of backwardly directed processes upon the seventh abdominal segment that stand opposed to the genital hooks. It differs venationally also in that the subcostal vein at its tip inclines toward the costa rather than toward the radius.

Genus ISOGENUS Newman.

1833. *Isogenus* Newman, Ent. Mag., 1:415.
1841. *Nephelion* Pictet, Perlides, p. 144.

Rather large concolorous grayish stoneflies of northward distribution. The prothorax is rectangular with a median yellow stripe. The second segment of the antennae is nearly as long as the first, and succeeding segments are all short, those of the tip attaining but half the length of the basal segment. The ocelli are very minute and widely separated. The middle segment of the tarsus is half as long as the basal segment and about a fifth as long as the third segment. The portion of the wings beyond the cord is long. The subcosta ends at or shortly before the cord. The fork of the median vein is narrow and its tips curve posteriorly at the margin, while the numerous branches of the radial sector arranged pectinately on the rearward side, tend to curve rather strongly at their tips in the opposite direction (forward). The middle abdominal segments bear large cushion-like pads in pairs upon the dorsal side. The 9th sternite is little prolonged into a subgenital plate. Segment 10 is cleft above for the accommodation of a retractile U-shaped supra-anal process, and the rear angles beside the cleft are produced and recurved into upturned obtuse, spinulose tipped genital hooks.

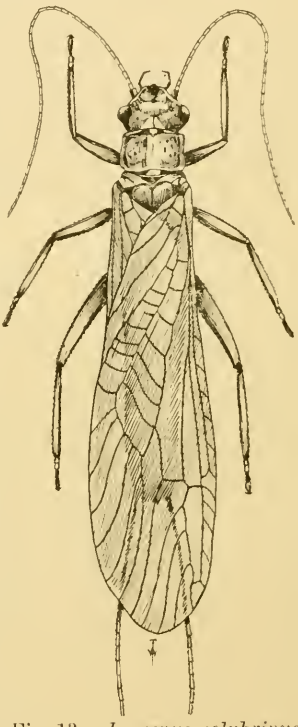

Fig. 13. *Isogenus colubrinus* Hag.

The three species herein included are distinguished from the species of Perla next following by very slight characters. We retain the name in deference to long usage.

Genotype, *Isogenus nebecula* Newman (European).

Key to the Species.

Males.

Lateral stylets of supra-anal process not reaching its cap ---------- *frontalis*
Lateral stylets of supra-anal process just reaching its cap ---------- *clongatus*
Lateral stylets of supra-anal process surpassing base of its cap ---------- *colubrinus*

Females.

Subgenital plate deeply and widely cleft--*frontalis*
Subgenital plate shallowly notched at its tip----
---------- *clongatus*
Subgenital plate narrowly and deeply cleft------
---------- *colubrinus*

Isogenus frontalis Newman.

(Plate 10, figs. 10, 13, 14, 15, 16; plate 11, fig. 1.)

1838. *Isogenus frontalis* Newm., Ent. Mag., 5:178.
1841. *Nephelion frontalis* Pict., Hist. Nat. Perlides, p. 172.
1861. *Isogenus frontalis* Hagen, Syn. Neur., N. A., p. 18.
1883. *Perla sulcata* Prov. Pet. Faun. Can., Neur., p. 74.
1918. *Perla titusi* Banks, Bull. Mus. Comp. Zool., 42:6.
1920. *Perla incesta* Banks, Bull. Mus. Comp. Zool., 64:318.

Length to wing tips, male, 18-24 mm.; female, 20-25 mm. Expanse of wings, male, 30-35 mm.; female, 36-42 mm.

Color brown to blackish, with a yellow stripe on the prothorax, and a large yellow triangular spot on the rear of the head. Head blackish above except for this spot (whose apex reaches forward to the suture behind the ocelli), and a pair of divaricate yellow dashes, that border the arms of the obscure transverse blackish frontal M-mark in front. Edge of mouth above and head beneath pale. Antennae and palpi brownish, the latter darker. Ocelli minute, the laterals half as far from the eyes as from each other.

Prothorax rectangular, about one fourth wider than long: its middle yellow line is divided by a sharp brownish longitudinal sulcus. The sides of the disc are densely covered with rather coarse blackish marmorate markings. The mesothorax is yellow before the wing roots, and diffusely so along the middorsal line. Legs brownish with

the usual yellow ring capping the femora at the knees. Wings subhyaline, with brown veins and a heavier infuscation upon the front of the cord and on the base of the radial sector. There is occasionally an extra crossvein between veins R and M, forming a closed cell beyond the cord. There is a heavy terminal branching of the radial sector, with the branches all springing to rearward and bending forward at their tips.

Abdomen brownish, somewhat lighter toward the tip. Tails yellowish brown, darkening toward the tip, much exceeding the folded wing tips, their cylindric segments clad with a short close pubescence.

Male. Abdomen upcurving at the end and concave on the dorsum of all the middle segments with lateral humps or pads formed upon 5 or 6 to 8, these cushionlike pads being oval or crescentic in form and covered with scurfy pubescence. Segment 9 is strongly narrowed above, being broadly and deeply concave on the rear margin above, and slightly produced to rearward beneath. The subgenital scoop thus formed is not well marked off at its side, but is crimped into a somewhat triangular gutter on the mid-ventral apical margin. Segment 10 is cleft in two on the dorsal side for the reception of the retractile U-shaped supra-anal process, whose basal attachment forms a triangular figure in brown at the base of the 10th tergite, there strongly chitinized. The halves of the 10th are again divided laterally by a deep notch, the rear border of which is a linear flattened process that curves forward and upward forming a genital hook, clad with long hairs posteriorly and with short chitinous prickles on its forwardly directed border. The retractile U-shaped supra-anal process bears a sharply decurved thornlike tip (Pl. 4, fig. 4) and a pair of minute, club-shaped, prickle-coated lateral stylets, and these are inclosed between two paragenital plates, from whose rear angles above project two slender thorn-like processes. Subanal plates small, obtuse-angled.

Female. The subgenital plate is as broad as the sternum, generally well set off at its sides by a deep oblique inwardly directed groove. Its apical margin overlaps upon the base of segment 9, is very broadly rounded, and deeply divided by a wide median notch.

A wide-ranging northern species of great variability in size and coloration, and even in genital characters, intergrading more or less completely with the two next following.

Distribution.—St. Martin's Falls, Albany River, Canada; Great Slave Lake; Dawson, Y. T. Canada, July 5, 1912 (J. M. Jessup); Grand Lake, N. F., July; Grand River, Canada, July 1, 1888 (L. Cabot), Apostle Is., Ashland Co., Wis., July 4-11, 1907; Niagara Falls, N. Y., June 24, 1901; Blackfoot, Idaho, June 22 (E. G. Titus).

Isogenus elongatus Hagen.

(Plate 10, figs. 12, 17.)

1875. *Isogenus elongatus* Hag., Bull. Geol. Surv. Terr., p. 576.
1907. *Isogenus elongatus* Banks, Cat. Neurop., p. 11.
1912. *Isogenus elongatus* Klap., Coll. Selys, 4:58.

Length to wing tips, male (short winged), 8 mm.; female, 24-28 mm.; to tip of abdomen, male, 14 mm. Expanse, female, 40-44 mm.

Color, brown varied with yellow. Head obscure brown, with a faint dark polished M-mark across the front, interrupted at the middle ocellus. An indistinct diffuse crown spot of yellowish is connected posteriorly with the apex of a more evident triangular spot upon the rear of the head; antennae concolorous, brownish. Palpi darker brown.

Prothorax rectangular, with the usual pale mid-dorsal stripe widening slightly to rear, and disappearing upon the front of the mesothorax. Legs concolorous, brownish except for the paler tips of the femora at the knees. Wings subhyaline with brown veins, and a faint wash of brown about the front end of the cord. They are so abbreviated in our male specimens as to cover only the basal half of the abdomen.

Abdomen blackish. Tails black.

Male. Abdomen brown, becoming blackish toward the tip and across the apices of segments, with a pair of obscure submedian pale dots close to the mid-dorsal line on each of the middle segments. Segment 9 is but little altered from the normal, a little abbreviated dorsally and elongated ventrally, but with no distinct elongation into a subgenital scoop—only a little narrow median depression of the extreme mid-ventral apical margin with a pair of impressions of the wall beside it. Segment 10 cleft above, as usual. Chitinized strongly at the sides where broadly exposed, thinner below. The edges of the cleft above are broadly emarginate with both angles pointed, the hinder one a little longer, acute, beset with about fifteen coarse prickles and erected and curved forward to form a low genital hook. The U-shaped supra-anal process bears a pyramidal transparent cap covered with mi-

nute outwardly directed prickles, and with its slender apex curved posteriorly in a small hook. There is also a sharp thorn-like spine pointing rearward from base of cap. In all this it is very similar to *I. frontalis* and *I. colubrinus*, but the terminal decurved tip appears to be less hooked than in those species, and the lateral stylets are a little longer, their tips reaching the level of the base of the terminal hook. The lateral stylets are half as long as the entire supra-anal process, stout, nearly straight, simple, blunt on apex, their distal third covered with microscopic denticulations in concentric lines.

Female. The subgenital plate is variable, but generally it is truncated squarely and bears a minute median notch, though this notch in some specimens is lacking.

Distribution.—Foothills of Colo. and Ogden, Ut. (female type and cotypes); Poudre River, Colo., June (U. S. N. M.); Platte Cañon, Colo., May (Dyar and Caudell); Montana Exp. Sta., Bozeman, Mont., May, 1920; Gallatin Co., Mont., May 23, 1917. Elevation 4,800 feet (R. A. Cooley).

Isogenus colubrinus Hagen.

(Plate 10, figs. 11, 18; plate 11, fig. 5.)

1875. *Isogenus colubrinus* Hag., Bull. Geol. Surv. Terr., p. 576.
1907. *Isogenus colubrinus* Banks, Cat. Neurop., p. 11.
1912. *Isogenus colubrinus* Klap., Coll. Selys, 4:59.

Length to wing tips, male, 18-20 mm.; female, 22-23 mm. Expanse, male, 26-32 mm.; female, 28-44 mm.

Color brown, with a middorsal stripe of yellow on the prothorax. Head brown, with a triangular yellow spot on the occiput, that sometimes extends forward between the ocelli. The transverse M-mark across the frons is polished, and its angles are all rounded off. At its outer end is a pair of pale spots near the antennae. Ocelli minute and spaced as in *I. frontalis*. Antennae and palpi brown.

Prothorax a little wider than long, rectangular with sharp angles; median yellow stripe widened at the front margin, and again toward the rear. Legs brown, darkened toward the knees, except for the usual pale line across the tip of each femur. Wings subhyaline, veins brown, with costal and subcostal veins a little paler than the others, a very slight darkening of the area about the front of the cord.

Abdomen brown: Tails brown except at base where they are yellowish, as are the subanal plates. The male genitals are very similar to *I. frontalis:* the genital hooks of segment 10 appear to be a little shorter; the pad-like

humps on the dorsum not so fully developed: they are usually distinct only on segments 8 and 9 (these are, however, very variable in appearance) ; and there seems to be the difference in the conformation of the tip of the supra-anal process that is shown in our figure in Plate 11 (fig. 5).

The subanal plate of the female is similar to that of *I. frontalis*, but its tip is usually more squarely truncated, and its dividing median notch is narrower.

A further study of the range of variability of the three preceding may determine that they constitute but one variable species.

The eggs of all of them are roundish oblong with a low wide reflexed collar at the micropylar end, this collar having about a fourth the width of the egg. In typical specimens of *I. frontalis* from Grand Lake, Newfoundland, the body of the egg is a trifle wider than in specimens ot *I. colubrinus* from the Columbia River.

Distribution.—Snake River, Idaho; The Dalles, Ore., June 23 (Hubbard and Schwarz) ; Umatilla, Ore., June 24 (S. Henshaw) ; Pullman, Wash., May 18, 1908; Rifle, Colo., June 23, 1904; Apostle Islands, Ashland Co., Wis., July 4-11; Port Huron, Mich., June (Hubbard and Schwarz) ; Medicine Hat, Assnba., June 13, 1905; Carbonate, B. C., Canada at 2600 ft. elevation (J. C. Bradley) Glenora, B. C.; Upper Mackenzie River (Kennicott) ; Ungva Bay, H. B. T. (L. M. Turner).

Genus PERLA Geoffroy.

1764. *Perla* Geoffroy, Hist. Ins., 2:229.
1842. *Perla* Pictet, Perlides, p. 141.
1923. *Perla* Klapalek, Coll. Zool. Zelys, IV, 2, p. 35.

A somewhat heterogeneous group of mostly rather large stoneflies having little else in common than the dorsally cleft 10th segment of the male abdomen: often, a supra-anal process of variable form occupies the cleft. There is a series of species (*hastata* and *bilobata*) having a rectangular prothorax with a median yellow stripe, radial sector forking far out, erect, well matched cord, and cubito-anal crossvein well beyond the apex of the anal cell. There is another contrasting series of species having the prothorax narrowed to rear and with rounded hind angles, lacking the median yellow stripe, radial sector more deeply forking and cord swung outward and the cubito-anal crossvein situated at or before the apex of the anal cell. Numerous divisions of the genus have been pro-

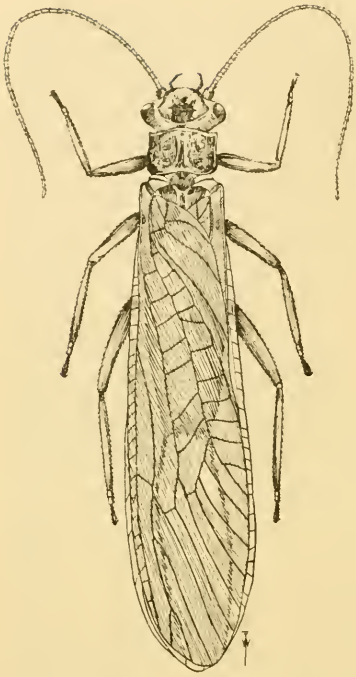

Fig. 14. *Perla immarginata* Say.

posed by Klapalek, but they have not been well defined. In so far as recognizable, our species will be found grouped under them in the systematic list at the end of the volume.

Genotype, *Perla maxima* Scopoli (European).

Key to the Species.

1. Cubito-anal crossvein of forewing (except in *P. phalerata*) situated more than its own length beyond the apex of the anal cell; first fork of vein Rs far out beyond the cord; male with segment 10 cleft dorsally and a retractile U-shaped supra-anal process occupying the cleft 2

   Cubito-anal crossvein of fore wing situated at the front of the anal cell or less than its own length beyond the apex of that cell; basal fork of vein Rs involved in the cord or not remote therefrom; male with no supra-anal process occupying the dorsal cleft of the 10th segment but with the edges of this cleft elevated into genital hooks 20

2. Male with no conspicuous lobes beneath abdominal segments 7 and 8 (occasionally a small lobe on 7): larger species 3

   Male with conspicuous lobes beneath both the 7th and the 8th segments, larger on 7: small eastern species 19

3. Cubito-anal crossvein well out beyond the anal cell 4

   Cubito-anal crossvein close to (somewhat less than its own length beyond) the anal cell; larger, western species with copious venation 17

4. First anal vein, beyond the anal cell, straight; costal apical crossvein very strongly aslant; tip of vein Sc equidistant from veins C and R; vein Rs 5-branched ---------- *innubila*
   First anal vein, beyond the anal cell, bent forward to meet the cubito-anal crossvein at an angle; tip of vein Sc usually much nearer vein C than vein R ---------- 5
5. Costal crossveins in the apical series not less numerous than in the proximal series--*alameda*
   Costal crossveins in the apical series fewer than in the proximal series ---------- 6
6. Tip of subcostal vein in the fore wing almost joins the costa; male with apical dorsal lobes of segment 10 developed as recurved genital hooks, and with tip of supra-anal process strongly decurved: the largest species (male, expanse 44 mm.) ---------- *crosbyi*
   Tip of subcostal vein less closely approximated to the costa; male with lobes of segment 10 not recurved mostly, convergent to rearward, and with tip of the supra-anal process not strongly decurved ---------- 7
7. Wing membrane subhyaline with brown veins--- 8
   Wing membrane brown ---------- 16
8. Blackish species with apex of abdomen yellowish ---------- 9
   Brownish or pale species with concolorous abdomen; western species ---------- 13
9. Veins Rs and M in hind wing fused for one-fifth the length of the disc ---------- 10
   Veins Rs and M in hind wing fused for one-seventh the length of the disc---------- 12
10. Top of head more black than yellow---------- 11
    Top of head more yellow than black; male with a ventral apical lobe on abdominal segment 7; subgenital plate of female very large and broadly rounded ---------- *expansa*
11. Yellow of the rear of the head extended forward into the ocellar triangle; rarely an extra r-m crossvein ---------- *postica*
    Yellow of the rear of the head restricted to a triangle bordering the occiput and not extended forward to the ocelli; usually with an extra r-m crossvein ---------- *varians*

12. Male with a distinct apical midventral lobe on abdominal segment 7. Larger northern species ---------- *hastata*
Male with no lobe on segment 7; smaller eastern species ---------- *fugitans*
13. Black species, with 3-lobed yellow spot on rear of head ---------- *nona*
Small pale species (max. expanse 30 mm.) with apical ventral lobe on 7th abdominal segment of the male ---------- 14
14. Three pale spots in a row across the rear of the head ---------- *aestivalis*
Yellow confluent across rear of the head ---------- 15
15. Yellow middorsal stripe of prothorax covering about a fourth of the width of the pronotum, not much constricted before the middle—Western ---------- *modesta*
Yellow middorsal stripe of prothorax covering much less than a fourth of the width of the pronotum and strongly constricted before the middle—Eastern ---------- *verticalis*
16. Rs forked far beyond the cord; fusion of veins Rs and M in hind wing short, about a sixth the length of the disc ---------- *tincta*
Rs with basal fork close to or involved in the cord; fusion of Rs and M in hind wing longer, equaling one-third the length of the wing disc ---------- *sorpta*
17. Median vein 3- to 4-branched ---------- 18
Median vein 2-branched ---------- *phalerata*
18. Legs blackish with no distinct pattern of yellow ---------- *obscura*
Legs brown with light yellow half rings before the knees ---------- *venosa*
19. Wing expanse 24 to 29 mm. Supra-anal process of male double ---------- *duplicata*
Wing expanse 18-24 mm. Supra-anal process of male single, telescopic ---------- *bilobata*
20. Cubito-anal crossvein opposite the apex of the anal cell, or very close thereto ---------- 21
Cubito-anal crossvein situated distinctly before the apex of the anal cell ---------- *capitata*

21. With two black stripes upon a yellow prothorax. Cleft of the 10th tergite in the male shallow _____ *luctuosa*
Prothorax not so marked; 10th tergite of male deeply cleft _____ 22

22. In the hind wing the 2nd anal vein is pectinately 6 to 7-branched. Ocelli very large_____*ramosa*
In the hind wing the 2nd anal vein is 3 to 5-branched _____ 23

23. Head and prothorax yellowish above; male genital hooks of the 10th tergite small and inconspicuous opposed by low lobes on the 8th and 9th tergites _____*kansensis*
Head and prothorax obscure brownish; the genital hooks of the 10th tergite in the male are very large and reach far forward_____ 24

24. With a rounded ventral hammer on the enlarged 9th sternite and no dorsal processes opposed to the hooks _____ 25
With no hammer on the 9th sternite, but with dorsal lobes on 5th tergite, opposed to genital hooks _____ 26

25. Subgenital plate of female straight-edged_____ _____ *languida*
Subgenital plate of female with a shallow median recession _____*sabulosa*

26. Genital hooks of male sharply pointed. Dorsal lobe of abdominal segment 5 with a narrow median apical notch. Female subgenital plate notched in the middle of a broad border_____ _____ *immarginata*
Genital hooks of male bluntly pointed; dorsal lobe of segment 5 with a wide rounded apical cleft. Female subgenital plate produced to rearward in a pair of teeth that stand beside and inclose a narrow notch _____*media*

Perla innubila, new species

(Plate 12, fig. 6; plate 17, fig. 20.)

Length to wing tips, female, 22 mm.; expanse, 38 mm. Color brown varied with yellow. Head brown above with a yellow cross band upon the middle half of the occiput, a pair of pale yellow triangles pointing inward between the lateral ocelli and the eyes, and all the front of the head before the antennae yellow. Antennae and palpi

yellowish brown. M-mark across the frons very obscure, showing by faint translucence in the midst of the brown. Eyes and ocelli both very small and equidistant in spacing.

Prothorax about twice as wide as long and a little narrowed posteriorly, with front margin convex and hind margins straight and both lineate with brown except at middle stripe. Bosses very few and coarse and ill defined. Middle yellow line very broad upon the collar, then narrowed to a line, then ovately rounded and then ending triradiately on the rear of the segment, the middle ray being continued upon the front of the mesothorax. Legs pale brownish; tarsi darker brown. Wings subhyaline with sharply defined and copious brown venation. The subcostal vein is strong and toward its tip it lies rather nearer to the radius than to the costa. The three apical costal crossveins are long and strongly aslant. The radial sector is 5-branched in both wings with a cord cell at its base next vein M. There are seven or eight crossveins in median and cubital area of fore wing. Fusion of veins Rs and M in the hind wing extends over about one-fifth the middle area, and the second anal vein is two or three branched and strongly sinuate; the third anal is less sinuate.

The abdomen is brown at the sides, paler dorsally and ventrally, and almost wholly yellow on segments 9 and 10. Tails yellow at base (broken off).

Male unknown.

Female. The subgenital plate is both wide and long, broadly rounded, obliquely incised at the base, extending across the 9th sternite, dark colored and clad with soft hairs on its ventral face.

The venation holds the best distinctive features for this species, which differs from its allies in having the base of the 1st anal vein in the fore wing nearly straight. The 2nd anal of the hind wing strongly sinuous, the subcostal vein running slightly nearer to vein R than to vein C and the apical costal crossveins very strongly aslant.

Distribution.—A single female holotype specimen from Sunburst, N. C., May 6, 1912.

Cornell University Collection.

Perla alameda, new species.

(Plate 12, fig. 2; plate 18, fig. 4.)

Length, male, 13 mm.; expanse, 24 mm.

Color smoky brown, varied with paler brown, yellowish

beneath. Head, yellowish brown with a diffuse brownish spot covering the ocelli and a faint suggestion of a paler triangle at the occiput. Antennae brown, paler at base of flagellum. Palpi long, dusky. Eyes very prominent and hind angles of head rather small. Ocelli a trifle nearer to each other than to the eyes.

Prothorax quadrangular with parallel sides a little wider than long, with rather acute angles. Middorsal pale stripe obscure, widened to rearward. Embossed markings well distributed over the sides of the disc but faint and ill-defined. Legs brown, pale beneath. Wings smoky hyaline throughout, hardly darker along the costa, the color due to close set brownish microscopic pubescence. Costal crossveins few and very faint before the subcosta, stronger in the apical space beyond. The 2nd and 3rd anal veins of the fore wing arise close together from the rear of the anal cell; in the hind wing the 2nd anal is two-branched, the 5th anal three-branched, and the fusion of veins Rs and M extends only one-sixth of the distance across the wing disc.

Abdomen yellowish brown, pilose. Tails of the same color at base, darkening toward their tips and very pilose.

Male. Abdominal segments normal to the 7th, which is slightly extended apically on the ventral side in a low broad lobe; 8 normal; 9 prolonged beneath into a subgenital scoop-like lobe that doubles its dorsal length. Segment 10 is cleft above in its apical half, and the rear angles beside the cleft are produced into rounded flat very hairy lobes that in contracted specimens overlap at their tips. Beneath them lies a long pointed tip of a supra-anal process inclined upward and blackish, and it is surrounded by a pair of pale slightly protruded paragenital plates.

Female unknown.

Distribution.—California. Four male specimens from San Antonio Creek, Alameda County, California, May 21, 1922 (B. C. Cain), bearing Stanford University Collection numbers "38-1, 2, 3, and 4." "38-2" is the holotype.

Male holotype and a male paratype, in the Cornell University Collection.

Perla crosbyi, new species.

(Plate 11, fig. 4; plate 17, figs. 7, 8.)

Length to wing tips, male, 21 mm.; female, 23 mm. Expanse, male, 42 mm.; female, 45 mm.

Colors yellow and brown with yellow tipped abdomen.

Head yellow entirely across both front and rear, the yellow of the occiput sending a lobe forward to the middle of the ocellar triangle. The brown is restricted to a broadly X-shaped mark covering rearward the ocelli and frontal tubercles, and forward the middle half of the M-mark of the frons. Between the hind ocelli and the eyes is a fainter wash of brown. Antennae and palpi pale brown, the palpi the darker brown.

Prothorax one-half wider than long, rectangular with parallel sides a little convex, and angles somewhat obtuse. Outside the lateral margin is a linear flat vertical declivous area. The yellow middorsal line is narrowest at the foremost of the bosses (between a pair of opposed 7-shaped ones) and is very wide behind. Bosses few and covering less than half the sides: the innermost line of them running rearward from the 7s is bordered externally by a series of broader irregular bosses and a single pair of curved bosses lies farther out toward the sides. The middorsal pale stripe is continued, first narrowly and then broadly upon the mesosternum, with extensive mottling over the remainder of the thorax, and with large fuscous spots at the sides of meso and metathorax beneath. Legs yellowish, brownish on the carinae, and blackish on the tarsi. Wings, subhyaline with rather heavy brown veins. There is a faint wash of fulvous along the stigma, and a heavier one along the costal space before the humeral crossveins. Between the latter and the tip of subcosta there are only two or three costal crossveins.

Abdomen brown with the two apical segments yellow. Tails brown with a few of the very short basal segments yellow. The tails are stouter and their hair coat shorter than in *P. varians*.

Male. The abdominal segments are normal to the 9th which is but little produced on the ventral side and moderately shortened dorsally. Segment 10 is deeply and widely cleft on the middorsal line, and the hind angles beside the cleft are produced into long recurved genital hooks that are linear, regularly curving and thinly clad with soft hair externally. The supra-anal process bears at its tip a linear, regularly arcuate, decurved process rounded on the downward end, and the paragenital plates beside its base appear to end in bluntly rounded edges, without angulation.

Female. Subgenital plate similar to that of *P. postica* but shorter, and with a minute median notch in its well chitinized tip.

Male holotype, female allotype, Cornell University Collection, from Missouri (C. R. Crosby).

Perla expansa Banks.

(Plate 11, fig. 7; plate 17, figs. 4, 5, 6.)

1920. *Perla expansa* Banks, Bull. Mus. Comp. Zool., 64:317.

Length to tip of wings, male 18-19 mm.; female, 21 mm. Expanse, male, 30-34 mm.; female, 36 mm.

General color brown, with a median light yellow line extending over the prothorax and top of head; last two segments of abdomen yellow.

Head as broad as prothorax, ocellar triangle nearly twice as broad as long, the posterior ocelli closer to the eyes than to each other. The lateral anterior margin raised and darker toward the eyes; the inner area near the raised margin with a number of dark wavy lines; clypeus infuscated with a darker spot near the posteriolateral angle. A black V-shaped mark connnects the ocelli and extends forward and outward about half way to the margin so that the black mark takes the form of a short and broad H. A dark rounded mark half way between the compound eye and the black ocellar mark. Area in front of and behind ocellar triangle light yellow; rest of head dark brown; back of head rugose. Antennae and palpi brown, antennae darker toward the tip.

Prothorax yellowish brown, a little wider than long, somewhat widened behind, anterior and posterior margins slightly convex, angles broadly rounded; a median yellow band slightly narrowed in the middle; a transverse sulcated line near the anterior and posterior margins; rugosities rather coarse and restricted largely to the inner halves of the sides of the disc; meso- and metathorax shiny dark brown, each with a light spot near the middle, mesothorax with a narrow median longitudinal line. Front wings brownish infuscated in the region of the cord; veins dark brown except the base of costa and subcosta, hind wings hyaline except for the brownish outer one-third.

Legs light brown, tibia with a narrow dark transverse band near the proximal end, tarsi darker.

Abdomen dark brown, with segments 9, 10 and 11 light yellow; tails yellow, hairy, the basal segments very short.

Male. Abdominal segments normal to the 9th, which is shortened above and greatly lengthened beneath apically, its subgenital scoop-like prolongation being broadly oval and thinly clad with hairs over the upturned surface.

Segment 10 divided above in the usual manner; a blackish V-mark on its base above marks the base of the U-shaped supra-anal process; the rear lobes of 10 above are flat, bluntly triangular, sparsely fringed on the hind margin with incurving hairs and beset with short stout pegs on the dorsal surface.

Female. Subgenital plate very large, about as wide as long, yellow, covered with fine long hairs, as wide as abdomen and extending beyond hind margin of segment nine; outer margin very broadly rounded.

Distribution.—Grant, Colo.; Lawn Lake, Estes Park, Colo., August 27, 1919, 10,500 ft. (P. W. Claassen); Tolland, Colo. (G. S. Dodds).

Perla postica Walker.

(Plate 11, fig. 3.)

1842. *Perla postica* Walker, Cat. Neur. Ins. Brit. Mus., p. 144.
1861. *Perla postica* Hagen, Syn. Neur. N. Amer., p. 23.
1904. *Perla postica* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Perla postica* Banks, Cat. Neurop., p. 12.
1921. *Perla subvarians* Banks, Bull. Mus. Comp. Zool., 64:317.

Length 10 to 15 mm.; expanse, 33 to 39 mm.

Color blackish or brownish, including antennae and palpi. Yellow triangular spot upon the occiput is prolonged forward between the ocelli in a usually parallel sided (sometimes tapering) tip and there are two oblique yellowish marks upon the sides of the clypeus before the bases of the antennae. Prothorax quadrangular wider than long with sides parallel and angles more or less acute. The yellow middorsal stripe upon the dorsum widens to rearward. Meso- and metathorax brown. Legs pale brown, darkened somewhat toward the knees where there is the usual yellow transverse pale ring across the tip of the femur. Wings subhyaline with brown veins, and in some specimens (all females, as yet noted) a wash of brownish covers the rear third or fourth of the hind wings, this being wholly confined to the folded anal area.

Abdomen brown, the two apical segments more or less yellow (more in the female): tails brownish to the base.

Male. Abdominal segments little modified before the 10th; 7, 8 and 9 successively a little more prolonged beneath, and 9 abbreviated dorsally, but the subgenital prolongation of 9 is very moderate, not scoop-like, and hardly set off by grooves at the sides. Segment 10 is cleft above and the rear angles of the cleft are elevated into strap-like lobes that are very hairy, beset also with stout short spinules on their forward margin, and rounded on the

tip. These present a very different appearance according to the way they are turned; they may lie flattened to rearward, or be lifted up erect, or even be turned a little forward, as genital hooks. Between them arises the long slender straight acute tip of the U-shaped supra-anal process.

Female. The subgenital plate is distinctly marked off upon the 8th sternite by oblique grooves and its free edge projects well backward upon the 9th sternite in an obtusely triangular lobe.

Distribution.—McKenzie River, Canada; Harrisburg, Pa., May 1 (H. A. Surface); Ft. Montgomery, N. Y. ♀ May 30, 1906: (wash of fuscous on rear one-half of hind wing); Fall Creek, Ithaca, N. Y., ♀ 16 May, 1921 (J. G. Needham); Rosslyn, Va., ♂ (F. C. Pratt); Gt. Falls, Va., May 12; Potomac River, Va., Apr. 18, 1907; Chain Bridge, Md. (H. Barber).

Perla varians Walsh.

(Plate 17, figs. 11, 12, and text fig. 3.)

1862. *Perla varians* Walsh, Proc. Acad. Nat. Sci., Philadelphia, p. 364.
1907. *Perla varians* Banks, Cat. Neurop., p. 12.

Length to wing tips, male, 11 mm.; female, 12 mm. Expanse, male, 32 mm.; female, 34 mm.

Color blackish, with the usual yellow middorsal stripe and yellow tipped abdomen. Head blackish with a wide yellow triangular spot upon the occiput and some paler indistinct edgings around the mouth and next the eyes. Ocelli about half as far from the eyes as from each other. Antennae brown; palpi a little paler brown.

Prothorax wider than long, about as wide as the head, quadrangular, with parallel sides and sharp front angles; rear a little convex and hind angles a little rounded. Rugosities upon the disc rather coarse and closely crowded toward the inner side. The dorsal pale line widens slightly to rearward and disappears upon the mesothorax. Legs brownish except for meager yellow knee cap line, and tarsi black. Wings subhyaline with blackish veins, that usually show a darker spot upon the stigma and in the base of the costal space. The venation is variable as illustrated in the introduction, but the closed cell outside the cord between veins R and M is usually present.

Abdomen dark brown with the extreme apex yellowish, more strongly and extensively so in the female. Tails brown except for a very few of the short basal segments, thickly clad with short hair.

Male. Segments 7, 8 and 9 a little elongated ventrally, 9 most so, but hardly scoop-like at the apex. Segment 10 divided dorsally as usual but with the rear lobes thus formed laid flat, not hook-like, but triangular and subangulate on the end, and covered with hair, almost lacking the usual forwardly directed spicules. Between these lobes projects the long pointed, tapering upturned tip of the U-shaped supra-anal process, with a pair of acute-angled paragenital plates projecting rearward beside it.

Female. The subgenital plate is nearly as broad as the abdomen, well marked off on the 8th sternite by a pair of oblique grooves; its free margin is ovately rounded, thinly hairy and overlaps well across the 9th sternite.

Distribution.—Rock Island, Ill.; Elkhart, Ind., June (R. J. Weith); Lake Geneva, Wis., May 9, 1892, "Fontana Park: crawling on leaves—small stream." No. 27257, Ill. State Lab. Nat. Hist. (S. A. Forbes); Riley Co., Kan., "K. S. A. C. 244" (G. A. Dean); Port Huron, Mich.; St. Paul, Minn.

Perla hastata Banks.

(Plate 11, fig. 2; plate 17, figs. 1, 2, 3.)

1920. *Isogenus hastatus* Banks, Bull. Mus. Comp. Zool., 64:314.

Color fuscous marked with yellow. Top of head mostly black with a crown spot of yellow between the ocelli, narrowly connected with apex of an occipital triangle of the same color, whose base spreads laterally across the hind margin of the head. The M-line before the middle ocellus is narrowly yellow and its two apices connect with a diffuse spot of the same color upon the side of the clypeus. Labrum yellowish; antennae and palpi fuscous.

Prothorax blackish with a middle yellow stripe that slowly widens to rearward, and that suddenly spreads out laterally on the flaring front margin. A mid-dorsal triangle of yellow on front of mesothorax points with its apex to rearward and there are other pale spots about the wing roots. Wings smoky hyaline with heavy dark brown veins. Legs fuscous, with pale knee caps. Venter of head and thorax mostly pale, with irregular narrow markings of fuscous that are median on the sternella, and broadly spread across the sterna of meso- and metathorax. Venter of abdomen obscure. Segment 10 and genitalia yellowish. Tails brown.

Some specimens show paired spots of yellow within the brown of the prothoracic dorsum toward the front, and smaller dashes of yellow across the frontal tubercles within the large brown area on the top of the head.

Male. Abdominal segments normal to the 6th, though the apical border of the 6th sternite is bordered with yellowish. Segment 7 slightly enlarged, the edges of the sternite produced in a yellow scurfy pubescent scoop-like border. Segment 8 similarly less produced. Segment 9 somewhat narrower, its sternite slightly produced, upturned and angulate in the rear, its entire rear margin yellowish. Segment 10 yellowish, cleft on the middorsal line, the rear angles beside the cleft produced obliquely to rearward in a pair of elongate triangular obtuse-tipped hairy lobes that lie nearly flat, and are not recurved at all to form genital hooks. Upturned tip of the U-shaped supra-anal process cylindric, very obtusely pointed, and bearing a pair of brown strongly chitinized claw-like lateral stylets near its middle.

Female. Abdominal segments 9 and 10 are yellowish and both are covered beneath by the subgenital plate of the 8th sternite which is produced rearward in a very broad scoop in the middle of whose hind border is a wide, shallow, rounded notch.

Distribution.—N. C. in May; White Mts., N. H.; Glen House, N. H. June 13 (C. W. Johnson); Camp Kennedy, Mt. Katahdin, Me., 3,000 ft., Aug. 1902; Old Forge, N. Y., Aug. 20, 1905 (J. G. Needham); Summit of Mt. Greylock, Mass., June 15 and June 11, 1906; Axton, N. Y., June 12-20, 1901 (A. D. MacGillivray and C. O. Houghton); Woodworth's Lake, June 23, 1910 (C. P. Alexander); Easton, N. Y., May 25, 1923 (M. D. Leonard); Ringwood Hollow, near Ellis, N. Y., May 21, 1922 (C. F. Wu).

Perla fugitans, new species.

(Plate 12, fig. 7; plate 17, figs. 13, 14.)

Length to wing tips, male, 15 mm.; expanse 28 mm.

Color brown varied with yellow. Head brownish above with a wide occipital band reaching nearly to the brown hind angles, with a median yellow extension forward to the middle of the ocellar triangle, constructed on the epicranial suture. Antennae and palpi dull brownish.

Prothorax quadrangular with straight and parallel sides and rather sharp angles; obscure rugosities upon the sides of the disc bordering the usual pale yellowish median line. This line is narrowed before the middle of the disc and widened again to rearward, and extended on to the middle of the mesothorax, very narrow in front but widened regularly backward on that segment. Legs brownish. Wings subhyaline with strong brown veins.

Abdomen brown, paler toward the base and on the extreme apex, darker at the sides; tails brownish with pale bases.

Male. Abdominal segments normal to the 9th which is elongate ventrally beneath the 10th in a short subgenital lobe. Segment 10 prominent. Cleft as usual on the middorsal line at the rear, but the angles beside the cleft are produced rearward in a pair of long, flat, backward-pointing, elongate, subtriangular lobes that are obliquely cut at tips and hairy on rear margins, while their inner edges bear stout pegs in a marginal series. The outer limb of the V-shaped supra-anal process is very long and rises erect from between the lobes of 10 in a thin erect tip with a minute barb on its anterior face near the tip.

Female unknown.

Distribution.—Texas; two males, Austin, Tex., March 1, 1903 (J. F. McClendon).

Male holotype and one male paratype in the Cornell University Collection.

Perla nona, new species.

(Plate 17, fig. 21.)

Length to tip of wings, female 18 mm. Expanse, 32 mm.

General color black with a conspicuous yellow middorsal stripe.

Head black with a huge yellow three-rayed spot upon the rear, the middle ray lying within the ocellar triangle, the outer rays out-curving to the eyes; another large yellow spot occupying the middle of frons and clypeus; antennae and palpi brown.

Prothorax quadrangular wider than long; convex at front and rear, with a broad median yellow stripe having jagged edges; median line continued narrowly to the middle of meso- and metathorax and followed on each by a narrow semi-circle, opening forward, pronotum rugose, wings subhyaline.

Abdomen dark brown; darker on sides and on apices of segments. Tails somewhat lighter brown.

Male unknown.

Female. Subgenital plate low and broadly rounded, covering only the base of the ninth sternite.

Holotype, female, Corvallis, Oregon (Cornell University Collection).

Perla aestivalis, new species.

(Plate 14, fig. 5; plate 18, figs. 7, 8, 9, 10.)

Length to wing tips, male, 10 mm.; female, 12 mm. Expanse, male, 18 mm.; female, 20 mm.

Color pale brown varied with pale yellow. Head brownish with three spots in a row across the head that are separated by the rear ocelli and the lateral ones of the row are dilated around the eyes. Another larger spot before the middle ocellus is more or less extended at the sides around the forward angles of the sinuous M-mark. There are also some obscure yellowish touches along the occipital border. Antennae and palpi brown.

Prothorax subquadrangular with all angles somewhat rounded, front margin broadly rounded, hind border slightly concave in the middle. Sides of the disc rather uniformly brown and with few slender obscure vermiculate embossed lines. Middorsal stripe of yellow rather narrow, somewhat widened toward the rear end and hardly continued upon the mesothorax. Legs brown. Wings yellowish hyaline with pale brown veins.

Abdomen pale brown, darker at sides, toward the tip and before the genitalia. Tails brown.

Male. Abdominal segments normal to the 7th whose sternite is slightly prolonged in the middle into a low broadly rounded lobe with a correspondingly broad notch at either side of it. The 9th segment is moderately prolonged beneath into the usual scoop-like upturned subgenital plate following. Segment 10 included in 9 below, broadly divided above by a median apical cleft, the hind angles of the cleft tergum being subtriangular with broadly rounded tips. The U-shaped supra-anal process possesses two long slender lateral stylets and its basal attachment is a subtriangular chitinous plate in the base of the wall of the 10th tergite, having the rear angles of the triangle cleft at the tip.

Female. The subgenital plate is long, its tip reaching well across the 10th sternite, broadly subtriangular with convex sides and rounded apex. The eggs of this species are carried extruded in a rounded mass beneath the tip of the abdomen. They are of a curious, lenticular form (Pl. 18, fig. 9).

This species is very close to the eastern *Perla duplicata* Banks, but is paler, slenderer, and smaller.

Holotype male, allotype female, Yellowstone National Park (R. Muttkowsky, in Cornell University Collection).

Perla modesta Banks.

(Plate 12, fig. 1; plate 17, fig. 16-19.)

1908. *Perla modesta* Banks, Trans. Amer. Ent. Soc., 34:255.

Length to wing tip, male, 10 mm.; female, 15 mm. Expanse, male, 15 mm.; female, 28-30 mm.

Color brownish, varied with amber yellow. Head brownish at the sides and across the front ocellus (where the color is deepest), with a big trapezoidal yellow spot before the occiput that widens forward and sends 3 lobes between and beside the rear ocelli. There is another pale spot before the middle ocellus and the mouth is pale. Antennae pale brown, the basal segment darker. Palpi yellow.

Prothorax quadrangular about as long as wide, with sides parallel and front and rear ends convex, the last with a small median concavity in the middle. Embossed markings on the sides of the disc faint and not numerous. Middle stripe of yellow parallel sided, and extended to rearward by a triangular spot of yellow upon the front of the brown mesothorax. Wings subhyaline with pale brown veins and with the apical costal space from the tip of the subcosta outward infuscated. Legs yellowish brown.

Abdomen yellowish brown, darkened at the sides and on the enlarged genital segments. Tails yellowish brown.

Male. The five short basal segments are ringed with brown across their apical margins. Segments 6 to 9 are longer and thickened. The sterna of 7, 8 and 9 all show subgenital modification, 7 having a ventral oval lobe with notches at its sides, 8 being darkened and thickened across its apical half and 9 being produced rearward into the usual oval upturning subgenital scoop that extends by a third the length of the segment. 10 is divided dorsally to accommodate the retractile U-shaped supra-anal process whose attachment is marked by a blackish spot on the middorsal line at the base of the segment: the apical angles of 10 are produced into elongate, triangular, prickle-beset lobes that incline upward and rearward.

Female. The subgenital plate is semicircular, its base covers most of the sternum of 8 and its apex extends well out upon segment 9. There are two darker spots beside its base, and two others in corresponding position on segment 9.

Distribution.—Boulder, Colo.; Tolland, Colo. (G. S. Dodds); Lawn Lake, Estes Park, Colo., Aug. 27, 1919 (P. W. Claassen); Florissant, Colo., June 1907; Beulah, N.

Mex., July 29 (T. D. A. Cockerell); Reno, Nev., 1878 (Morrison).

Perla verticalis Banks.

((Plate 14, fig. 8; plate 18, figs. 13, 14, 15.)

1920. *Perla verticalis* Banks, Bull. Mus. Comp. Zool., 64:318.
1920. *Isoperla isolata* Banks, Bull. Mus. Comp. Zool., 64:322.

Length to wing tips, male, 13-14 mm.; female, 14-16 mm. Expanse, male, 22-25 mm.; female, 24-30 mm.

Color dull brown varied with yellow. Head yellowish. Head brownish with a large triradiate yellow spot upon the occiput; the three rays extending forward between and beside the rear ocelli. Pale also before the middle ocellus. Hind angles broadly black. Antennae and palpi pale brown.

Prothorax quadrangular with rounded angles and convex front and rear margins, the latter a little retuse in the middle. Middorsal yellow stripe rather narrow. Sides of disc brown faintly embossed with numerous obscure vermiculate embossed markings. Legs pale brown. Wings subhyaline with pale brown veins.

Abdomen brown, paler about the genitalia. Tails brown, rather hairy at base.

Male. Abdominal segments normal to the 7th which has a low midventral apical lobe set off at the sides by widely rounded emarginations. Segment 8 normal: 9 a little extended and upturned below, 10 cleft above with the lobes beside the cleft subtriangular, rounded on tip. Supra-anal process with long lateral stylets. Basal attachment plate of two crescentric lobes conjoined end to end like the halves of a figure 3.

Female. Subgenital plate yellowish, elongate rounded triangular, obtuse at the apex which extends well across the 10th sternite.

Distribution.—Franconia, N. H. (Mrs. A. T. Slosson); Elkhart, Ind., June (R. J. Weith); Sunburst, N. C., May 2, 1912 (C. S. Brimley).

This may possibly prove to be *P. picta* Pict.

Perla tincta, new species.

(Plate 14, fig. 3; plate 17, fig. 15.)

Length to wing tips, female, 18 mm.; expanse, 32 mm.

Color black varied with tawny yellow and with smoky wings. Head black with a yellow occipital triangle whose apex just reaches the level of the hind ocelli. M-mark across the front black, shining, with minute extra angulations. Frontal tubercles crescentic transverse, promi-

nent, black, shining. Eyes and rear ocelli equidistant. Antennae and palpi black.

Prothorax with narrow median groove in the yellow band, and with wide transverse grooves setting off at front and rear collar and cape, both of which are a little convex. Side margins straight and parallel. Embossed markings in a dense double row each side next the middle stripe, and a single large one farther toward the hind angle; all these bosses are shining black on the dull gray background of the disc. Dorsal stripe yellow, wider behind and spreading diffusely beyond the transverse grooves. Thorax and legs black. Wings strongly tinted with amber brown, more deeply at base and along the subcostal space. The cord jogs outward on the radial sector, which branches far beyond it once or twice. The costal space lacks crossveins from one-half to one-third the distance from humeral crossvein to the cord. The anal vein in the hind wing is two-branched and not sinuate. Wing membrane covered with a microscopic brownish pubescence.

Abdomen black except for the yellow rear margin of the 9th and 10th segments; tails black.

Male. Unknown.

Female. Subgenital plate similar to that of *P. varians*, broadly rounded, covering most of the 9th sternite, blackish in color.

Holotype, female, North Carolina, Cornell University Collection.

Perla sorpta, new species.

(Plate 12, fig. 4; plate 25, fig. 10.)

Length to wing tips, female, 17 mm.; expanse, 30 mm.

Color brown varied with yellow. Head mostly yellow above, dark brown around the sloping hind angles. There is a ring of paler brown containing the 3 ocelli and entirely surrounding a yellow crown spot between them, and from this ring an obscure band of brown extends obliquely forward each side to the base of the antennae. Basal segment of antennae brown, the remainder lost. Palpi, pale yellowish brown. Ocelli about equidistant from each other and from the eyes.

Prothorax fully one-third wider than long, brown, with a yellow middorsal band covering one-third its width, parallel sided but diffuse and ill-defined laterally.

Legs, pale brown. Wings subhyaline with brown veins. There are two oblique crossveins in the apical space. The tip of the subcosta lies some distance before the cord.

The fusion between veins Rs and M in the hind wing extend one-third the length of the wing disc.

Abdomen pale brownish, darker at the sides and toward the tip. Tails (basal portion only preserved) yellowish brown.

Male. Unknown.

Female. Subgenital plate broadly oval, evenly contoured, completely overlapping the ninth sternite.

Distribution.—California. One female taken from the stomach of a trout caught in Marblefork Giant Forest, King's River Trail, Sequoia National Park, between 6,500 and 7,100 ft. altitude on July 24, 1907. Cornell University collection. Mounted on two slides (J. C. Bradley).

Perla phalerata Smith.

(Plate 17, figs. 9. 10.)

1917. *Dictyogenus? phaleratus* Smith, Trans. Amer. Ent. Soc., 43:485.

Length to wing tips, female, 21 mm. Expanse, 32 mm.

Color yellowish, phalerate with black; a broad, black triangle on frons, with apex to rear; a large black four-rayed spot on top of head, U-shaped in front, the hollow of the U surrounding the rear point of the frontal triangle, anterior rays running outward and backward to the eyes, posterior rays overspreading the paired ocelli. Balance of head yellow, excepting two vertical tubercles and two smaller black, shining spots at lateral angles of frontal triangle.

Prothorax quadrate, nearly twice as broad as long, with broad yellow median stripe divided with black on the middle suture and bordered outside by an obscure line of blackish, embossed markings; a few larger embossed markings farther out, half way to the lateral margin. Thorax broadly lined with black on all sutures. Legs, lineate with black on all carinae with a sharp transverse band at each joint and a diffuse one a little above each knee joint.

Abdomen blackish on sides, yellowish beneath, with interrupted transverse rows of black dots across the middle of the segments.

The wings are hyaline with brown veins. There is a full complement of costal crossveins, and there are in the type a few extra crossveins between the branches of the radial sector.

Miss Smith doubtfully referred this species to Dictyogenus, noting at the time that it lacked a strong basal angulation of the 1st anal vein in the fore wing, and that

the wings are relatively long with open meshwork of veins. Its nearest ally is *Perla modesta*, from which it differs in venation by the possession of the crossveins above mentioned, and by a much shorter fusion of veins Rs and M in the hind wing.

Only one specimen, the female type, from New Mexico, is known; the second specimen (from Colorado) mentioned by Miss Smith is *Perla modesta*.

Perla obscura, new species.

(Plate 25, fig. 15.)

Length to wing tips, female, 17 mm.; expanse, 30 mm.

Color blackish, with a broad yellow thoracic stripe and yellow tipped abdomen. Head blackish at the sides, and across the middle ocellus where the color is deepest. There is a long yellow inverted-mushroom-shaped spot on frons and clypeus. A broader yellow spot covers the rear of the head, rounded in front where it fills the ocellar triangle, widened in small lobes behind the rear ocelli, and again upon the occipital border. Rear ocelli equidistant from the eyes and from each other; middle ocellus a little smaller than the others. Antennae and palpi blackish.

Prothorax a little wider than long, a very little narrowed to rearward, sharp angled, very faintly and diffusely embossed upon the black sides of the disc. Median yellow stripe bright yellow, parallel sided, ragged edged. This stripe terminates in a triangular spot on the mesothoracic praescutum, lateral to which is a pair of smaller pale spots. Legs blackish with an obscure wash of yellowish on the femora just before the knees. Wings flavescent-hyaline, especially in the disc and along the costa, with brown veins, and rather copious venation, the median vein being three-branched.

Abdomen blackish except for a yellow tip, and tails blackish.

Male unknown.

Female. Yellow on abdominal segments 9 and 10 and the extreme base of the tails and the sternum of 8 at the sides of the blackish subgenital plate. The latter is ovate, evenly rounded, and almost reaches the apex of the 9th sternum.

This species is close to the preceding, agreeing in general type of coloration and venation. It can hardly be the same species, for it is too small, details of coloration are different, the tip of the fore wing is shorter and the

anal area of the hind wing is broader and the median vein has fewer branches.

Distribution.—Oregon Caves, Josephine Co., Ore., July 23, 1922 (E. C. VanDyke).

Female holotype in the California Academy of Sciences.

This may possibly be the female of the following species *P. venosa*, but the relative size of the sexes does not indicate this.

Perla venosa, new species.

(Plate 11, fig. 8; plate 18, figs. 11, 12.)

Length to tip of wings, 20 mm.; expanse, 35 mm.

Color brown with a very broad yellow middorsal stripe. Head brown at the sides deepening and connected across the middle ocellus; broadly yellow in front on labrum and clypeus and with a small inverted mushroom-shaped spot in the brown before the middle ocellus. Space between the ocelli wholly yellow, continuous and wider to rearward, and continuous with the broad stripe upon the prothorax. Antennae and palpi yellowish brown. Eyes and ocelli very small, the rear ocelli a little nearer to each other than to the eyes. Hind angles of the head behind the eyes rather prominent.

Prothorax hardly broader than long, sharp angled. The middorsal yellow stripe covers a third of its entire width; the edges of the stripe are parallel but ill-defined. Embossed markings subobsolete, limited to a few obscure, ill-defined oblique streakings. Legs brown with a dorsal half ring of bright yellow just before the knees. Wings flavescent-hyaline with brown veins. The apex of the wing (portion beyond the cord) long and vein tips unusually numerous, especially the branches of the median vein.

Abdomen brown; tails paler.

Male. Abdominal segments normal to the 7th. Sternum of segment 7 emarginate at sides and extended apically into a scoop-like lobe; margin pilose. Sternum of 8 similar, less extended but more pilose; sternum of 9 much more extended, its ventral length being 3 times the dorsal, and obliquely truncate apically from above downward, a very little angulate and upcurved on the midventral line, pale on the scoop-like portion and pilose externally. Segment 10 included ventrally in 9, cleft above, and the edges of the cleft are laterally divided in a rounded notch between two similarly rounded angles that lie flat on the back; between the four lobes thus formed

lies the black 5-rayed chitinous base of the supra-anal process behind which a pair of ( )-shaped brownish paragenital plates encircle the tip of that process.

Distribution.—California; a single male specimen from Fieldbrook, Calif., May 30, 1903 (H. S. Barber, in U. S. National Museum).

Perla duplicata Banks.

(Plate 18, figs. 5, 6.)

1920. *Perla duplicata* Banks, Bull. Mus. Comp. Zool., 64, No. 3:316.

Length to tip of wings, male, 13-15 mm.; female, 16-17 mm. Expanse, male, 24-26 mm.; female, 27-29 mm.

General color brown, with infuscated wings and with a median yellow stripe on prothorax. Head yellowish with an infuscated spot over the ocellar triangle; also darker on the clypeus and behind the eyes; frontal ridge low, indistinct; lateral tubercles not prominent; ocelli small, the hind ocelli a little closer to the eyes than to each other. Antennae brown.

Prothorax chocolate brown, with a wide median yellow stripe and sometimes a little paler on the sides; narrower than the head, wider than long; narrowed behind; angles rather sharp; front and hind margins somewhat convex; surface moderately rugose. Legs brown, tibiae and tarsi darker; a narrow, transverse, black band at end of femora; first and second tarsal segments short, subequal, third tarsal segment very long. Wings quite smoky; subcosta ends much before the cord; a series of costal crossveins before the end of subcosta and several beyond; radial sector with 3-4 branches.

Abdomen yellowish, darker above; tails yellowish to brown.

Male. Seventh and eighth abdominal sternites each with a rounded, median, knob-like appendage, the one on the seventh sternite much larger than the one on eighth; ninth sternite much produced and rounded behind; tenth tergite cleft behind on each side with a rounded, raised, spinulose knob directed inward; ninth tergite reduced to a narrow collar; supra-anal process normally retracted within the tenth segment; when extended it consists of two slender chitinous, recurved processes lying side by side, each somewhat enlarged at the tip and basally surrounded by a membranous sheath; subanal lobes broadly triangular, unmodified.

Female. Hind margin of eighth abdominal sternite produced into a large, rounded subgenital plate which reaches entirely across the ninth sternite.

Distribution.—Type, male, June 4, 1911, Fairfax Co., Va. (Banks Coll. Mus. Comp. Zool., Cambridge, Mass.); three males, one female, June, 1912, Black Mts., N. C. (Beutenmüller); one female, July, 1903, Newfoundland, N. J.

Perla bilobata, new species.

(Plate 18, figs. 1, 2, 3; plate 14, fig. 7.)

Length to tip of wings, male, 10-12 mm.; female, 12-14 mm. Expanse, male, 18-21 mm.; female, 21-24 mm.

General color brown with a median, yellow prothoracic stripe and with the wings lightly to heavily infuscated. Head a little wider than prothorax, yellowish brown with a darker mark over the ocellar triangle and with a dark spot on the clypeus; frontal ridge and lateral tubercles not prominent; ocelli small, hind ocelli closer to the eyes than to each other. Antennae yellowish brown.

Prothorax yellowish to chocolate brown, with a yellow median stripe; wider than long; slightly narrowed behind; angles rounded (in pinned specimens almost sharp); surface only slightly rugose. Legs yellowish brown, a narrow black transverse band at end of femora; first and second tarsal segments short, subequal; third segment long. Wings lightly to heavily infuscated; subcosta ends considerably before the cord; a series of costal crossveins before the end of subcosta and several beyond; radial sector usually with three branches.

Abdomen and tails yellow.

Male. Seventh and eighth abdominal sternites each with a median, rounded, knoblike appendage, the larger one on the seventh sternite; ninth sternite somewhat triangularly produced; ninth tergite slightly emarginate behind and spinulose each side of the median line; tenth tergite cleft and each side with a rounded, raised lobe closely beset with short pegs; supra-anal process normally retracted; when extended it consists of a basal, membranous sheath and a central, slender, chitinous recurved process which bears at the tip a long, slender, lash-like filament; subanal lobes broadly triangular, unmodified.

Female. Hind margin of eighth abdominal sternite produced into a broad, evenly rounded subgenital plate which normally does not extend entirely across the ninth sternite.

Holotype male, allotype female, July 19, 1905, Old Forge, N. Y. (J. G. Needham); Paratypes, many specimens, males and females, July 16-19, 1905, Old Forge, N. Y. (J. G. Needham); three males, two females, June-Aug., Black Mts., N. C. (Beutenmüller).

Perla capitata Pictet.

(Plate 13, fig. 8; plate 19, figs. 1, 2, 3, and text fig. 4.)

1842. *Perla capitata* Pictet, Ins. Neurop., p. 214.
1852. *Perla capitata* Walker, Cat. Neurop. B. M., p. 150.
1861. *Perla capitata* Hagen, Syn. Neurop. N. A., p. 22.
1902. *Perla capitata* Banks, Can. Ent., 34:123.
1907. *Perla capitata* Banks, Cat. Neurop., p. 11.
1923. *Phasganophora capitata* Klap., Coll. Selys, IV. 2:92.
1861. *Perla tristis* Hagen, Syn. Neurop. N. A., p. 22.
1904. *Perla tristis* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Perla tristis* Banks, Cat. Neurop., p. 12.
1861. *Perla annulipes* Hagen, Syn. Neurop. N. A., p. 22.
1904. *Perla annulipes* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Perla annulipes* Banks, Cat. Neurop., p. 11.
1923. *Perla annulipes* Klap., Coll. Selys, IV. 2:95.
1862. *Perla flavescens* Walsh, Proc. Acad. Nat. Sci. Phil., p. 363.
1876. *Perla flavescens* Prov. Le Nat. Can., p. 73.
1907. *Perla flavescens* Banks, Cat. Neurop., p. 11.
1923. *Perla flavescens* Klap., Coll. Selys, IV. 2:93.
1883. *Perla hieroglyphica* Provancher, Pet. Faun. Can. Neurop., p. 73.
1907. *Acroneuria hieroglyphica* Banks, Cat. Neurop., p. 11.
1883. *Perla marginipes* Provancher, Pet. Faun. Can. Neurop., p. 73.
1900. *Perla americana* Banks, Trans. Amer. Ent. Soc., 26:243.
1904. *Perla americana* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Perla americana* Banks, Cat. Neurop., p. 11.
1908. *Perla illustris* Banks, Trans. Am. Ent. Soc., 34:256.
1918. *Perla innota* Banks, Bull. Mus. Comp. Zool. Cambridge, 62:6.

Length to wing tips, male, 16-18 mm.; female, 20-24 mm. Expanse of wings, male, 26-30 mm.; female, 35-40 mm.

Color brown with yellowish abdomen. Head with a black spot on the ocellar triangle extending outward before the frontal tubercle toward the base of the antennae. Ocellar triangle longer than wide, the rear ocelli and the eyes about equidistant from each other. Antennae blackish brown, yellowish along the base of the flagellum. Palpi dark brown.

Prothorax brown, concolorous. Sides straight slightly convergent rearward, front margin convex, the frontal angles sharp. Hind angles are broadly rounded. Rugosities of the disc are coarse and densely crowded. Legs brownish above and yellowish beneath, tarsi blackish. Wings subhyaline, yellowish along the costal border, the ends brown.

Abdomen yellowish varied with brown, darker at the tip, the last segment yellow. Tails brown.

Male. Abdominal segments normal to the 5th which is greatly modified on the dorsal side, the apical margin notched at the sides and prolonged in the middle in a backward directed triangular prominence that is deeply notched in the middle of its rounded apex. This prolonga-

tion meets the recurved genital hooks of the 10th segment and the dorsum of segments 6, 7, 8 and 9 lying between are concave and somewhat membranous and more or less excavate on the apical margin of the tergum. Segment 10 is divided on the middorsal line and the hind angles are produced upward and forward in a pair of remarkably long, strong, genital hooks that are at first incurved and then run parallel to their oblique, rounded spinulose anteriorily directed tips. There is a line of prickles on the posterior face of each at midway its length.

Female. The subgenital plate is marked off at the sides by a groove upon the 8th sternite and is produced posteriorly in a low broad triangle, rounded (and occasionally emarginate) at the tip.

Distribution.—

New York, Ithaca, May 28, June 2, July 19; McLean, June 9; West Falls, July 15; Malloryville, June 20; North Fair Haven, shore of L. Ontario; Gloversville, June 13, 1910 (C. P. Alexander); Nassau, June 22; Clyde, July 26; Ogdensburg, July 19, 1906 (C. Betten); Binghamton, July 22; West Branch, Ausable R., Essex Co., July 1, 1923 (P. W. Claassen).
Maryland, Plummers Island, June 19 (M. V. Warner); Laurel, July 23 (E. B. Marshall).
Massachusetts, Springfield (G. Dimmock).
Pennsylvania, Harrisburg, July 6.
Minnesota, Minnehaha, June 7.
Canada, Quebec.
Nova Scotia, Truro, June 2, June 24, July 17 (R. Matheson).
Indiana, Elkhart, June 18.
Illinois, Ottawa, July 2 (W. E. Howard).
Michigan, Ann Arbor, June 27.
Kansas, Riley Co., June 22, Popenoe.
Mississippi, Agricultural College, H. E. Weed.
Tennessee, Knoxville, June 24.
North Carolina.

Perla luctuosa Banks.

(Plate 12, fig. 8; plate 18, figs. 16-19.)

1906. *Perla luctuosa* Banks, Can. Ent., 38:336.
1907. *Perla luctuosa* Banks, Cat. Neurop., p. 12.

Length to wing tips, male, 17 mm.; female, 21 mm.; expanse, male, 29 mm.; female, 34 mm.

General color orange and black with yellowish wings.

Head a little wider than prothorax; orange yellow with a large black area over the entire ocellar triangle and extending forward upon the clypeus; frontal ridges dark brown; area just behind the eyes brownish; lateral tubercles indistinct; antennae yellowish at base, darker towards the tip.

Prothorax orange yellow with a wide dark blackish strip on each side or rather with a wide orange median stripe and a narrow yellowish stripe on each lateral margin; pronotum nearly twice as wide as long, narrowed behind; front angles subacute, hind angles narrowly rounded; surface not very rugose. Legs yellowish; ends of femora with a narrow transverse blackish band; wings slightly tinted with greenish yellow; venation as in Plate 12, fig. 8.

Abdomen dark brown, somewhat lighter toward the tip; tails yellowish, darker towards the tip.

Male. Abdominal segments normal to the 8th which bears a low wide ventral triangular apical lobe, ciliate margined, and set off at the sides by shallow excisions of the border. Segment 9 is prolonged beneath to twice its dorsal length. Rearward this ventral portion is smoothly contoured, rounded and up curving with inrolled edges above. Dorsally segment 9 is strongly chitinized, squarely truncated with a minute black denticle at the middle and another at sides of the flat truncate dorsum. At the sides it is frailer, membranous and emarginate to rearward. Segment 10 is wholly included in 9 beneath and partly above; on the dorsal side it is divided by a deep median cleft and the rear angles beside this cleft rise in a pair of genital hooks that are slender, recurved above, and truncate. The subanal lobes rise between these hooks in a pair of slender pale delicate upturned processes; supra-anal process short and upcurved.

Female. Subgenital plate somewhat produced and medially with a deep rounded notch which is about as wide as it is deep.

Distribution.—San Francisco, Cal., 2 females; Mary's Peak, Ore., "596," July 16, 1911.

Perla ramosa, new species.

(Plate 19, fig. 17; plate 13, fig. 1.)

Length to wing tips, female, 28 mm.; expanse, 52 mm.

General color yellowish varied with brown. Head yellowish above except for a brownish inverted V-mark between the ocelli and joining them, and a wash of the same

color extending from the middle ocellus to the antennae and reappearing on the sides of the head behind the eye. Ocelli very large and close set, the hind ones twice the size of the median, and separated from each other by little more than the diameter of one of them; twice as far removed from the eye. Antennae yellowish beyond the yellowish brown basal segment. Palpi yellowish.

Prothorax a little wider than long, sides contracted on the posterior third, front margin convex, hind margin straight or hardly rounded, the angles are sharp; disc nearly smooth; middorsal yellow stripe is narrowed in the middle. Meso- and metathorax yellowish brown. Legs yellowish with a narrow dark band crossing the tip of the femora. Tarsi darker toward the tip. Wings uniformly subhyaline with pale brown veins. The second anal vein of the hind wing is remarkable for the number of its branches, all pectinately arranged on the posterior side.

Abdomen yellowish brown, tails brown. The basal segment is longer than wide, and succeeding segments 2, 3 and 4 are wider than long.

Male unknown.

Female. Ventral plate produced over at least one-half of the 9th sternite, broadly rounded, very slightly emarginate in the middle. On the ventral margin of the 9th sternite each side there is a transverse, elongate triangular area closely covered with short, spiny hairs that bend forward.

Holotype, female, Ithaca, N. Y. (Cornell University Collection.)

Perla kansensis Banks.

(Plate 19, figs. 11, 12.)

1905. *Perla kansensis* Banks, Psyche, 11:56.

Length to wing tips, male, 21 mm.; female, 22 mm. Expanse, male, 34 mm.; female, 36 mm.

Color yellowish brown, head concolorous above except for the rings of black pigment bordering the ocelli internally and ocelli and eyes about equidistant. Antennae and palpi brownish.

Prothorax wider than long, greatly narrowed to rearward with broadly rounded hind angles, straightish between them, the front margin strongly convex. Surface of the sides of the disc slightly rugose. Meso- and metathorax brownish, legs brown. Femora with a narrow dark band at the tip. Tibiae broader than usual, inner edges somewhat swollen, tarsi brown. Wings pale yellowish, the venation only slightly darker.

Abdomen brown, lighter beneath, especially the anterior portion. Tails brown, darker toward the tip, very hairy.

Male. Abdominal segments normal to the 7th which only differs from preceding segments by a patch of prickles on the dorsum either side of the middle line, the dorsum of the 8th segment carries besides similar dense patches of prickles a little triangular tubercle on the apical margin, the 9th segment is concave posteriorly upon the dorsum and little prolonged on the ventral side underneath the 10th segment. The 10th segment is cleft on the dorsum and the hind angles beside the cleft are elevated in a pair of processes that are at first erect and then sharply bent forward and approximated at their tips, which stand opposed to the middle median tooth on the apex of the 8th segment. Externally these genital hooks are very hairy.

Female. The subgenital plate of the female is an ill-defined prolongation of the 8th sternite, triangular in form, overlapping more than half the length of segment 9, conspicuously emarginate at the tip with the two lobes beside the notch rather bluntly pointed and parallel or incurving. A pair of small, brownish, oval spots mark the sides of the 9th sternite.

Distribution.—Kansas, Douglas County in July. Riley County in September, Lawrence, June 23, 1919 (P. W. Claassen).

Perla languida, new species.

(Plate 13, figs. 5, 7; plate 19, figs. 18, 19, 20.)

Length to wing tips, male, 18 mm.; female, 28 mm. Expanse, male, 23 mm.; female, 43 mm.

Color brown and yellow, mostly pale. Head yellow across the rear and around the eyes. A brownish spot fills the ocellar triangle and extends forward and laterally behind the obscure M-line to the roots of the antennae, and a brownish cloud occupies the middle of the clypeus. Antennae brownish yellow, paler along the base of the flagellum. Palpi yellow. Ocelli more than twice as large in the male as in the female, the paired ones more than twice as large as the median, and separated by little more than their diameter (three times as far apart in the female); more than twice as far from the compound eyes.

Prothorax subrectangular, hardly as wide as head, narrowing a little to rearward. Front and hind margins are convex, especially the former. The middorsal suture may be either brown or yellowish. The embossed markings are

rather low, broad streakings, outcurving to rearward. Praescutum of meso- and metathorax yellow, behind which brown predominates on the dorsum. Legs yellowish brown without pattern, but darker near the knees and on the tarsi. Wings abbreviated, especially in the male (covering only about half of the abdomen in that sex) dull brownish, subhyaline, with veins a little deeper brown. Abdomen yellowish, darkening toward the tip in the male, and becoming yellowish in the female, with tails of corresponding colors.

Male. The 9th abdominal segment is prolonged a little on the ventral side and upcurved, with a pair of narrow longitudinal folds half the depth of the segment marking off the sides of the subgenital scoop thus formed. On the middle of the most convex portion is a circular disc-like cornicle or hammer which is whitish and bare. The 10th segment is widely cleft above, the rear angles beside the cleft are produced into thick, stout genital hooks, that are first tapering and curving inward, and then linear and curving forward, their convergent obtuse tips reaching forward well above the 9th tergite. They are yellowish at the sides and brownish at their tips.

Female. The subgenital plate is a low, broad, convex extension of the 8th sternite that reaches hardly one-fourth way across the 9th sternite. The eggs are broadly oval with the micropyle at the broad end and a transparent, close-fitting micropylar cap covers almost half of the egg surface.

Distribution.—Holotype male, allotype female, Yellowstone River, Wyoming, Aug. 5, 1921 (F. M. Sallee, in Cornell University Collection). Paratypes, same locality, many males and females: Troy, Mont., August (J. C. Bradley); Beaver Creek, Mont., 6,300 ft., Aug., 1913 (S. J. Hunter).

Perla sabulosa Banks.

(Plate 13, fig. 4.)

1900. *Perla sabulosa* Banks, Trans. Amer. Ent. Soc., 26:242.
1907. *Perla sabulosa* Banks, Cat. Neurop., p. 12.
1907. *Perla sabulosa* Banks, Can. Ent., 39:328.

Length to wing tips, female, 33 mm. Expanse, female, 58 mm.

Color pale yellowish brown. Head yellow with a diffuse brownish spot occupying the ocellar triangle and extending laterally around the frontal tubercles. Ocelli and eyes about equidistant. Antennae and palpi brown.

Prothorax of uniform yellowish brown color, scarcely narrowed behind, front angles sharp, hind angles rounded,

front margin convex. Rugosities rather strong, pattern irregular. Meso- and metathorax brown, the former with a pale spot at the front. Legs brown, lighter underneath, with tarsi darker. Wings very broad, uniformly subhyaline. Veins few and interspaces are wide.

Abdomen yellowish brown, darker toward the tip, underneath yellowish except the last three segments. Tails brown, covered with fine, short pubescence.

Female. Subgenital plate of the female little developed, the apex of the 8th sternite scarcely produced, its margin soft and varying in form according to the extent of contractions, normally straight but frequently a little infolded in the middle in a wide apical notch.

Male unknown.

Distribution.—Known only from the type locality, which is Yakima, Wash.

Perla immarginata Say.

(Plate 19, figs. 7-10; plate 13, fig. 2.)

1823. *Perla immarginata* Say, Godman's West. Quart. Rept., 2:164.
1861. *Perla immarginata* Hagen, Syn. Neurop. N. A., p. 20.
1892. *Perla immarginata* Banks, Cat., p. 342.
1907. *Perla immarginata* Banks, Cat. Neurop., p. 1.
1908. *Perla immarginata* Banks, Proc. Ent. Soc. Wash., 9:150.
1908. *Perla immarginata* Banks, Trans. Amer. Ent. Soc., 34:257.
1909. *Perla immarginata* Klap. Bull. Acad. Boh., 14:13.
1913. *Perla immarginata* Smith, Ann. Ent. Soc. Am.
1902. *Perla fumosa* Banks, Can. Ent., 34:123.
1907. *Perla fumosa* Banks, Cat. Neurop., p. 11.

Length to tip of wings, male, 24-30 mm.; female, 35-39 mm. Expanse, male, 42-50 mm.; female, 62-68 mm.

General color dark brown, varied with yellow.

Head a little wider than prothorax, dark brown to blackish over the ocellar triangle and with black on the inside of the ocelli; lateral tubercles large, with a depression in the center; frontal ridge not prominent; occiput yellowish; hind ocelli a little closer to each other than to the eyes, especially in the female; antennae dark brown to blackish.

Prothorax brown to blackish; wider than long, considerably narrowed behind; disc quite rugose; angles rather sharp. Legs brown to blackish. Wings subfumose; veins dark brown; subcosta ends just beyond the cord; many costal crossveins before the end of subcosta as well as beyond.

Abdomen yellowish; tails yellowish at base, darker towards the tip, closely beset with short hairs.

Male. Abdominal segments normal to the fifth, the fifth tergite much produced rearward into a bilobed process, with a deep narrow notch between the lobes, the lobes closely beset with short prickles; tergites 6 to 9 largely membranous; 6 and 7 smooth, 8 with many prickles and behind with a small median lobe; the 9th tergite usually also has a few prickles; the 10th tergite bears a pair of genital hooks as shown in Plate 19, figures 8 and 10; abdominal sternites 3, 4 and 5 armed with stiff hairs and 6, 7 and 8 with hairs and prickles; ninth sternite slightly produced and rounded behind; subanal lobes triangular, unmodified. The metasternum bears a patch of stiff hairs.

Female. The hind margin of the eighth abdominal sternite slightly produced into a subgenital plate, which is medially notched as shown in Plate 19, fig. 7.

Distribution.—

New York, Ithaca, March 25 - Sept. 24; Ithaca, Coy Glen, July 22; Keen Valley, Aug. 9, 1889; Wilmington, Essex Co., Aug. 11, 1888; Ludlowville, Mt. Whiteface, Aug. 22-24, 1916; Hamilton Co.; Ogdensburg, July 18, 1906; Enfield, July 25, 1920.

Pennsylvania, Ohio Pyle, Aug. 8, 1905.

New Hampshire, Jackson, Sept. 22 (Owen Bryant).

Maine, Eagle Lake, Sept. 8, 1907 (J. A. Cushman).

Georgia, Tallulah Falls, June 19-26, 1909 (J. C. Bradley).

North Carolina, Black Mts., June, 1912 Beutenmüller).

Quebec, Chatianguay.

Perla media Walker.

(Plate 13, fig. 3; plate 19, figs. 4, 5, 6.)

1852. *Perla media* Walker, B. M. Cat. Neurop., p. 145.
1861. *Perla media* Hagen, Syn. Neurop. N. A., p. 24.
1892. *Perla media* Banks, Cat., p. 342.
1907. *Perla media* Banks, Cat. Neurop., p. 12.
1923. *Phasganophora media* Klap. Coll. Selys, IV, 2:95.
1861. *Perla lurida* Hagen, Syn. Neurop. N. A., p. 21.
1907. *Perla lurida* Banks, Cat. Neurop., p. 12.

Length to tip of wings, male, 20-22 mm.; female, 26-32 mm. Expanse, male, 35-38 mm.; female, 45-54 mm.

General color dark brown to blackish, varied with yellow.

Head very little wider than prothorax; frontal ridge, lateral tubercles and occiput yellowish, rest of surface mostly black, deepest black over the ocellar triangle; lateral tubercles large, prominent; hind ocelli closer to each other than to the eyes; antennae brown at base, darker towards the tip.

Prothorax dark brown to blackish; wider than long, much narrower behind; front angles acute, hind angles obtuse; surface quite rugose, the rugosities often lighter brown. Legs brown. Wings subfumose, veins brown; subcosta ends at the cord; a series of costal crossveins before the end of subcosta and beyond.

Abdomen yellowish, tails yellowish to brown.

Male. Abdominal tergites 1 to 4 normal, the fifth produced backward into a bilobed process with a broad shallow emargination between the lobes which are beset with many prickles; tergites 7, 8 and 9 partly membranous above and medially beset with many prickles; the tenth tergite bears a pair of genital hooks, as shown in Plate 19, figure 4; ninth abdominal sternite somewhat produced behind and evenly rounded; abdominal sternites 2-8 beset with stiff hairs which are thickest on segments 3-6. There is also a heavy patch of stiff hairs on the metasternum and some on the mesosternum. Subanal lobes unmodified.

Female. Hind margin of eighth sternite medially somewhat produced into a bilobed subgenital plate, as shown in Plate 19, figure 5.

Distribution.—

Quebec, Saguenay River, July 25, 1906 (George P. Englehardt); Ottawa, Sept. 7.

New York, Ithaca, May 31-July; Niagara Falls, July 12 and July 6; Crane Pond, June 25, 1897; Oswego, June 21, 1894; Fulton, June 20, 1890; Wilmurt, Herkimer Co., June 10; Ogdensburg, July 16, 1906; Buffalo, July 9, 1906.

Minnesota, Minneapolis, May 25, 1922 (William E. Hoffman).

Genus ALLOPERLA Banks.

1906. *Alloperla* Banks, Ent. News, 17:175.
1907. *Alloperla* Banks, Cat. Neurop., p. 13.

Small yellowish or greenish species, eight to fifteen mm. long; with three ocelli; pronotum transversely oval or with very broadly rounded angles; second tarsal segment very short; wings yellowish to greenish. Head not much wider than prothorax; hind ocelli not much closer

to eyes than to each other; antennae yellow at base and beyond usually infuscated; apical segment of maxillary palpi very small.

Prothorax mostly transversely oval, i. e. the angles broadly rounded; wider than long, often one and one-half to two times as wide as long; just inside the margin a groove which is continuous all around the pronotum; surface not very rugose; either uniformly yellowish or yellowish with dark markings. Legs yellowish; usually with a narrow, transverse dark band at the end of the femora and the tarsi usually darker toward the tip. Wings yellowish or greenish hyaline (much more pronounced in living specimens); Cu2 of forewing very short, originating at a point nearly opposite the tip of the first anal vein; second anal vein of forewing branched; no cubital crossveins in hind wings except the ones at the end; subcosta drops down to radius a considerable distance before the cord; several costal crossveins before the end of subcosta and one or more beyond; anal field of hind wings narrow but with at least two veins.

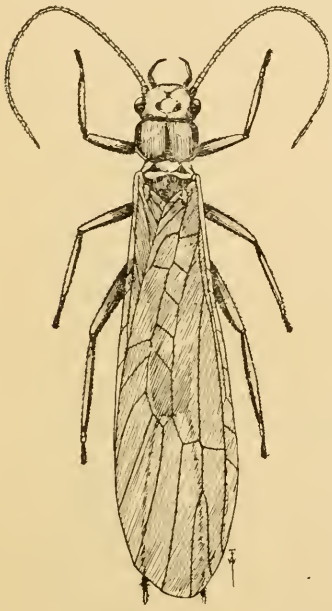

Fig. 15. *Alloperla marginata* Banks.

Abdomen mostly yellowish and usually with a median dorsal dark stripe which extends to the seventh or eighth tergite. Cerci or tails quite long, yellowish, hairy.

Male. Tenth abdominal tergite cleft; eighth or ninth tergite often with a raised tubercle; supra-anal process either upturned or recurved over the abdomen; ninth tergite, and sometimes eighth, medially depressed to allow the supra-anal process to lie within the groove thus formed; subanal lobes small, unmodified; ninth abdominal sternite produced and usually somewhat truncate behind, smooth below.

Female. Hind margin of eighth abdominal sternite produced into a variously modified subgenital plate.

Genotype, *Sialis imbecilla* Say.

Key to the Species of Alloperla.

Males.

1. Tenth tergite with an inward pointing hook each side at the base of tails; supra-anal process indistinct, very short, largely membranous, with a small rounded knob at tip 2
   Tenth tergite without inward pointing hooks at base of cerci; supra-anal process distinct, usually long and heavily chitinized 3
2. Western species ..... *pallidula*
   Eastern species ..... *marginata*
3. Eighth abdominal tergite (antepenultimate segment) with a raised, notched tubercle; supra-anal process broadly spatulate; sides of pronotum black ..... *pacifica*
   No tubercle on eighth abdominal tergite (though a tubercle is often present on the anterior margin of the ninth tergite) 4
4. A distinct, raised chitinous tubercle on the ninth abdominal tergite (penultimate segment) 5
   Ninth abdominal tergite without a distinct raised tubercle 12
5. Yellowish, with lateral margin of pronotum blackish, rest of pronotum and head yellowish; supra-anal process either very long and slender or else flattened and evenly rounded at the tip; mostly Eastern species 6
   Yellowish with the rugosities on prothorax blackish and with blackish markings on the head (*continua* Bks. usually with a dark median stripe on head and prothorax) supra-anal process not long and slender (except *borealis*, the largest species of the genus) 7
6. Supra-anal process very long, slender, upturned ..... *lateralis*
   Supra-anal process short, flattened, broad, and at the tip evenly rounded ..... *novascotiana*
7. Tubercle on ninth tergite deeply notched; supra-anal process much enlarged beyond the base and at the apex with a sharply pointed small process 8
   Tubercle on ninth tergite not distinctly or deeply notched; supra-anal process rather slender and without a sharply pointed tooth or process at the tip 10

8. Supra-anal process with a median dorsal carina; the lower anterior portion of the supra--anal process with a slender, spine-like process; penis with two, black, chitinized leaf-like appendages above ---------- 9

Supra-anal process flattened above; at the tip with a very short, upturned hook (wide in side view); penis without chitinized leaf-life appendages above ----------*coloradensis*

9. Median carina of supra-anal process low; penis with a broad, bilobed, black, chitinized process above (this process is usually retracted within the body but can be distinguished through the ninth abdominal sternite)---*lamba*

Median carina of supra-anal process low; penis with two long, chitinized leaf-like processes above (these processes are usually not retracted entirely within the body and are usually seen protruding below the last segment)------ ---------- *albertensis*

10. Prothorax with a dark narrow margin and with the rugosities blackish ---------- 11

Prothorax without dark margin but with a median longitudinal dark stripe; supra-anal process binodose, attenuate at the tip------*continua*

11. Ocelli usually connected by a V-shaped dark mark; supra-anal process slender, not much enlarged in the middle and bluntly pointed------ ---------- *borealis*

Ocelli usually not connected by a dark mark; supra-anal process enlarged in middle (dorsal view) and pointed at the tip----------*fidelis*

12. Pronotum with blackish lateral margins; supra-anal process flattened, dorso-ventrally; broadly spatulate in dorsal view----------*spatulata*

Pronotum without blackish lateral margins; supra-anal process not broadly spatulate in dorsal view ---------- 13

13. Head with a large triangular, blackish, spot over the ocellar triangle and another one in front of the anterior ocellus; pronotum usually with a broad median blackish line, widened at both ends; supra-anal process small---------*signata*

Head yellowish without any striking dark marks; pronotum not with a well defined broad median dark line ---------- 14

14. Pronotum usually with a median ill defined dark stripe; ninth abdominal tergite with a suggestion of a tubercle; supra-anal process very broad at base (side view) and with a slender upturned process at the tip ---------- *mediana*
Entire insect usually pale yellowish or greenish (except *lincosa*, which sometimes shows a narrow dark line on pronotum) supra-anal process either slender or very small ---------- 15
15. Abdomen with a dorsal dark stripe (in *lincosa* usually also a narrow dark line on pronotum); western species ---------- 16
Entire specimen pale yellowish, without dark dorsal line on abdomen ---------- 17
16. Pronotum usually with a narrow dark line; eight to nine mm. long; supra-anal process very short, with a small chitinized knob at the tip ---------- *lincosa*
Pale yellowish; eleven to fourteen mm. long; supra-anal process, when extended, quite long and consisting of a chitinized process surrounded by a membrane, rounded at the tip ---------- *pilosa*
17. Supra-anal process, raised, ending in a rounded knob with a serrate anterior margin; western species ---------- *serrata*
Supra-anal process not ending in a rounded knob, and usually not with a serrate anterior margin; eastern species ---------- 18
18. Supra-anal process very slender, finger-like, gradually tapering to a point ---------- *imbecilla*
Supra-anal process more or less flattened, never finger-like ---------- *nanina*

Alloperla pallidula Banks.

(Plate 22, figs. 12, 13.)

1904. *Chloroperla pallidula* Banks, Trans. Amer. Ent. Soc., 30:99.
1907. *Alloperla pallidula* Banks, Cat. Neurop., p. 13.
1918. *Alloperla infirma* Banks, Bull. Mus. Comp. Zool., Cambridge, Mass., 62. No. 1:6.

Length to tip of wings, male, 7-9 mm.; expanse, male, 13-16 mm.; length to tip of wings, female, 8-10 mm.; expanse, female, 15-19 mm.

General color pale greenish yellow with lateral margins of prothorax blackish. Head hardly wider than prothorax; pale yellow with a little black around the ocelli, hind ocelli a little closer to the eyes than to each other.

Antennae yellow at base, somewhat infuscated towards the tip.

Prothorax transversely oval, wider than long; pale yellowish with narrow dark lateral margins, the dark line tending to follow completely around the pronotum; slightly rugose. Legs yellow, tarsi a little darker. Wings pale greenish hyaline, veins pale.

Abdomen yellow with a broad dark median dorsal stripe. Cerci yellow.

Male. Tenth abdominal tergite broadly cleft; at the base of the cerci an inward pointing finger-like process; supra-anal lobe very short, largely membranous and clothed at the tip with hairs; subanal lobes small, unmodified; ninth sternite somewhat produced and truncated behind.

Female. The hind margin of the eighth abdominal sternite produced into a large, broadly rounded, subgenital plate which extends to the tip of the abdomen.

Distribution.—Type, female No. 11346, Aug., Beulah, N. Mex. (Banks Coll. Mus. Comp. Zool., Cambridge, Mass.); one female, July 18, 1898, Little Beaver, Colo.; one female, July 25, 1914, Graham Mts., Ariz.; many males and females, Aug., Estes Park, Colo., (P. W. Claassen); one male, June 30, 1907, Florissant, Colo. (T. D. A. Cockerell); one male, Aug., Platte Canyon, Colo. (Oslar); males and females, Boulder, Colo. (G. S. Dodds); one female, Aug. 19, Eldora, Colo. (T. D. A. C.); three males, two females, June, Olympia, Wash. (Kincaid); one male, two females, Reno, Nev. (Morrison); many males and females, Aug. 1913, Beaver Creek, Mont. (S. J. Hunter); one female, Three Rivers, Calif. (Culbertson); four females, May and June, Humboldt Co., Calif. (H. S. Barber); two males, May 23, 1917, Niles Canyon, Calif. (W. M. Giffard); one female, May 17, 1908, Marin Co., Calif. (E. C. Van Dyke); one female, July 15, 1917, Muir Woods, Marin Co., Calif. (W. M. Giffard); one female, June 24, 1920, Nanaimo, B. C. (E. C. Van Dyke); three females, May 21, 1922, San Antonio Creek, Alameda Co., Calif. (B. C. Cain); two females, Yellowstone Park; two males, three females, July 9-26, 1923, Waterton Lakes, Alberta, Canada (J. McDunnough).

This is the western representative of *marginata*.

Alloperla marginata Banks.

(Plate 22, figs. 10, 11.)

1897. *Chloroperla marginata* Banks, Trans. Am. Ent. Soc., 24:21.
1907. *Alloperla marginata* Banks, Cat. Neur., p. 13.

Length to tip of wings, male, 8 mm.; expanse, male, 14 mm.; length to tip of wings, female, 9-10 mm.; expanse, female, 16-18 mm.

General color pale yellowish with the lateral margins of prothorax usually blackish.

Head hardly wider than prothorax, pale yellow; ocelli black; hind ocelli closer to eyes than to each other; antennae yellowish at base, somewhat infuscated towards the tip; palpi yellow, last segment of maxillary palpi small.

Prothorax about as wide as head, transversely oval, wider than long, yellow; lateral margins usually with a narrow dark line; surface somewhat rugose. Legs yellow, tarsi darker. Wings hyaline with a yellowish green tinge, veins yellowish; subcosta reaches to a point somewhat beyond the middle of the origin of the radial sector and the cord.

Abdomen yellow with a broad blackish median dorsal stripe over at least the first seven segments. Cerci yellow, closely beset with long hairs.

Male. Supra-anal process represented by a short, broad membranous lobe which bears at the tip a small round knob which is thickly clothed with hair; subanal lobes small triangular, unmodified; at the base of each cercus the tenth tergite bears an inward pointing slender process; ninth abdominal sternite produced and somewhat truncate behind.

Female. Subgenital plate of eighth abdominal sternite as broad as the eighth segment and greatly produced into an evenly rounded plate which in dried specimens reaches to the tip of the abdomen.

Distribution.—Type, female No. 11348, July 6, 1895, Colden, N. Y. (Banks Coll. Mus. Comp. Zool., Cambridge, Mass.).

Four males, five females, Aug., Mt. Katahdin, Me.; one female, June 20, 1922, Moore's Brook, Ithaca, N. Y. (C. K. Sibley); one female, Milw. Co., Wis. (F. R.); one male, Mt. Greylock, Mass.

Alloperla pacifica Banks.

(Plate 22, figs. 2, 3.)

1895. *Chloroperla pacifica* Banks, Trans. Am. Ent. Soc., 22:313.
1907. *Alloperla pacifica* Banks, Can. Ent., 39:329.
1907. *Alloperla pacifica* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 9.5-10 mm.; expanse, male, 16-18 mm., length to tip of wings, female, 11-12 mm.; expanse, female, 19-21 mm.

General color yellowish with the lateral margins of pronotum blackish. Head slightly wider than prothorax, yellowish, a little darker on clypeus; lateral tubercles and frontal ridge weakly indicated; a narrow black ring around the ocelli; hind ocelli a little closer to eyes than to each other; antennae yellow, darker toward the tip.

Prothorax transversely oval, wider than long; yellow to yellowish brown; pronotum with black or dark brown lateral margins; disc slightly rugose, the rugosities sometimes a little darker. Legs yellowish, tarsi a little darker. Wings pale yellowish hyaline, veins yellow to brownish.

Abdomen yellow with a broad blackish median dorsal stripe. Cerci yellow.

Male. Anterior margin of eighth abdominal tergite with a raised, transverse tubercle notched at posterior margin; (in pinned specimens this appears to be on the seventh tergite) tenth tergite deeply and widely cleft; ninth tergite with a median depression in which the supra-anal process normally lies; supra-anal process recurved, flattened and broadly spatulate; subanal lobes small, unmodified; ninth sternite somewhat produced and truncate behind.

Female. Eighth abdominal sternite with a broadly rounded sub-genital plate which in dried specimens extends over the entire ninth sternite or even on to the tenth; the plate normally bulges out considerably in the center.

Distribution.—Type, female No. 11347, May, Skokomish River, Wash. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); three females, May 2, 14, 18, Bon Accord, B. C.; two females, July 9, 1901, Port Renfrew, B. C., in Banks Collection; five females, six males, 1878, Reno, Nev. (Morrison); one female, two males, May 17-29, Yosemite Valley, Calif. (E. C. Van Dyke); one female, June 14, 1908, Lagunitas, Marin Co., Calif. (E. C. Van Dyke); one female, July 25, 1907, Mt. Jefferson, Oregon (J. C. Bridwell); one female, May 31, Cultis Lake, Chilliwock, B. C. (F. C. Ewing).

Alloperla lateralis Banks.

(Plate 21, figs. 6, 7.)

1911. *Alloperla lateralis* Banks, Trans. Am. Ent. Soc., 37:337.

Length to tip of wings, male, 9.5-11 mm.; expanse, male, 17-20 mm.; length to tip of wings, female, 10.5-13 mm.; expanse, female, 20-23 mm.

General color yellowish with a narrow black margin around the pronotum. Head hardly wider than prothorax; pale yellowish with a little black around the ocelli; frontal ridge and lateral tubercles weak; hind ocelli a little closer to the eyes than to each other; antennae yellowish at base becoming dark towards the tip.

Prothorax transversely oval, almost twice as wide as long; pronotum with a narrow blackish margin all around; surface somewhat rugose, the rugosities a little reddish or brownish. Legs yellow, tarsi a little darker. Wings yellowish or greenish hyaline; veins greenish yellow.

Abdomen yellowish, with a broad blackish median dorsal stripe. Cerci yellowish, a little darker towards the tip.

Male. Tenth abdominal tergite broadly and deeply cleft, the lobes each side bearing long hairs; ninth tergite much depressed posteriorly and on the anterior margin with two raised rounded knobs or tubercles; supra-anal process recurved, long and slender with the tip turned up; subanal lobes small, unmodified; ninth sternite produced and truncate behind. In its normal position the tip of the abdomen is somewhat turned up and tergites eight, nine and ten are telescoped together with the supra-anal process completely hidden in the cleft portion of nine and ten.

Female. Subgenital plate of eighth abdominal sternite narrowly and triangularly produced so that normally the tip of the plate extends to the tip of the abdomen; plate normally with a median longitudinal ridge.

Distribution.—Type, female No. 11354, May, Black Mts., N. C. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); cotypes, three females, one male, same locality as type; one male, one female, June 13, Gloversville, N. Y.; two females, June 25, Woodworth Lake, Fulton Co., N. Y.—All in Banks's Coll. Four males, May 20-25, 1911, Black Rock Mt., Raban Co., Ga. (J. C. Bradley); males and females, May and June, Ithaca, N. Y.; one female, June 10, De Ruyter, N. Y.; one female, June 23, 1910, Woodworth Lake, Fulton Co., N. Y. (C. P. Alexander); two males, June 13, 1910, Gloversville, N. Y. (C. P. A.); males and females, June, Danby, N. Y.; one female, June 12, Ram-

apo, N. Y.; one female, June 11, 1915, Mix Creek Valley, Cattaraugus Co., N. Y.; one male, two females, June 26, Mt. Tom, Mass. (C. W. Johnson); one female, July 20, Bar Harbor, Me. (C. W. Johnson); one female, July 11, 1908, Mt. Ascutney, Vt. (C. W. J.); one male, July 17, 1875 Mt. Washington, N. H. (Geo. Dimmock); one female, July 28, 1915, Mt. Washington, N. H. (C. W. J.); one female, June 20, Jaffrey, N. H. (C. W. J.); two females, June 10, 1920, Mt. Monadnock, N. H. (C. W. J.); one female, June 11, 1916, Glen House, N. H. (C. W. J.); one female, June 24, 1913, Bretton Woods, N. H. (C. W. J.); two males, July 17, Kaslo, B. C. (R. P. Currie).

Alloperla novascotiana, new species.

(Plate 22, fig. 1.)

Length to tip of wings, male, 10 mm.; expanse, male, 17 mm.

General color yellow, the prothorax with a dark margin. Head a little wider than prothorax; yellow with an infuscated mark connecting the ocelli and exending over the clypeus; a dark area behind the eyes; ocelli with a black crescent on the inside; hind ocelli closer to the eyes than to each other; antennae yellow at the base, infuscated towards the tip.

Prothorax transversely oval, nearly twice as wide as long; yellow with a narrow dark brown margin; surface slightly rugose, the rugosities somewhat darker. Legs yellow, tarsi a little darker at the tip. Wings greenish hyaline, veins greenish yellow.

Abdomen yellow with a brown median dorsal stripe and with the posterior margins of the abdominal tergites darker. Cerci yellow at base, infuscated towards the tip.

Male. Tenth tergite broadly cleft; anterior margin of ninth tergite with a transverse, raised, chitinous, tubercle which is slightly emarginate; supra-anal process widened into an almost evenly rounded lobe (pestle-shaped as viewed from above); subanal lobes small, unmodified; ninth sternite produced and truncate behind.

Female unknown.

Holotype male, Truro, Nova Scotia, July 4, 1913 (R. Matheson, Cornell University Collection).

Alloperla coloradensis Banks.

(Plate 22, figs. 4, 5.)

1898. *Chloroperla coloradensis* Banks, Trans. Am. Ent. Soc., 25:199.
1907. *Alloperla coloradensis* Banks, Can. Ent., 39:328.
1907. *Alloperla coloradensis* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 8-9 mm.; expanse, male,

14-16 mm.; length to tip of wings, female, 10-11 mm.; expanse, female, 18-20 mm.

General color yellow with dark spots on head, with the margin and rugosities of pronotum dark brown and with abdomen brown.

Head hardly wider than prothorax; yellowish, with a V-shaped dark mark connecting the ocelli; frontal ridge and lateral tubercles dark and a dark patch behind the eyes. The dark marks on the head are often interrupted so that the head appears to have six or more dark spots. Hind ocelli a little closer to the eyes than to each other; antennae yellowish at the base, blackish towards the tip.

Prothorax transversely oval, almost twice as wide as long; yellow, with a narrow blackish margin and with the rugosities blackish. The blackish margin is usually interrupted in the median portion both in front and behind. Legs yellowish, tarsi a little darker. Wings yellowish brown, veins brown.

Abdomen brown, with darker median dorsal stripe. Cerci yellowish brown.

Male. Tenth abdominal tergite broadly and deeply cleft; ninth tergite with a depressed area behind and near the front margin with raised chitinous process which is triangularly notched; supra-anal process recurved, flattened above and at the tip with a short, sharply upturned hook; the greatest width (viewed from above) of the supra-anal process equals about half its length; subanal lobes small, unmodified; penis, when extruded, entirely membranous, without black chitinized lobes or processes; ninth abdominal sternite produced and truncate behind.

Female. Subgenital plate of eighth sternite produced somewhat triangularly and broadly truncate behind or even slightly emarginate behind; center and hind margin of plate beset with stout hairs.

Distribution.—Type, female No. 11350, Colorado (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); two females, Aug. 3, one male, two females, July 29, Tolland, Colo.; two females, Aug. 22, Boulder, Colo.; one male, July 25, Bluebird, Colo.; many males and females, Boulder, Colo. (G. S. Dodds); one male, June 3, 1879, Manitou, Colo.; one female, Aug. 3, 1921, Estes Park, Colo. (P. W. Claassen); one male, June 20, 1906, Big Blackfoot River, Potomac, Mont.; two males July 4, 1908, Emerald Lake, Canadian Rockies (J. C. Bradley); one female, July 11, Beulah, N. Mex.

Alloperla lamba, new species.

(Plate 14, fig. 4; plate 22, figs. 8, 9.)

Length to tip of wings, female, 9-10 mm.; expanse, male, 16-18 mm. Length to tip of wings, female, 10.5-12 mm.; expanse, female, 18.5-21 mm.

General color very similar to *coloradensis*, yellow, with dark spots on head, with the margin and rugosities of pronotum dark and with abdomen dark brown.

Head hardly wider than prothorax; yellow with a dark V-shaped mark connecting the ocelli, with the frontal M-ridge, the lateral tubercles and clypeus dark brown; also a dark spot behind the eye. (There is quite a little variation in the size of these dark markings.) Hind ocelli a little closer to the eyes than to each other; antennae yellow at the base, blackish toward the tip.

Prothorax transversely oval, almost twice as wide as long; yellow with a narrow blackish margin and with the rugosities dark brown. Legs yellowish to brownish, tarsi darker at the tip. Wings greenish to slightly brownish infuscated, veins mostly brown. Meso- and metanotum dark brown.

Abdomen brown, with a darker median dorsal stripe and with the posterior margins of the tergites darker. Cerci yellowish or light brown.

Male. Tenth abdominal tergite widely and deeply cleft; ninth tergite quite deeply emarginate behind and on the anterior margin with a transverse raised, triangularly notched tubercle; supra-anal process recurved, nearly three times as long as its greatest width (dorsal view), with a dorsal, median, membranous carina; at the tip with a slender, slightly upturned, process which originates from the lower anterior portion of the supra-anal process; penis at the tip bilobed and near the base with a dorsal bilobed, flattened, black, longitudinally striated appendage which is wider than long (when the penis is retracted this chitinized lobe can usually be seen from below through the ninth abdominal sternite); subanal lobes small, unmodified; ninth sternite produced and truncate behind.

Female. Subgenital plate of eighth sternite somewhat triangularly produced and behind broadly rounded; clothed with long hairs.

Holotype male, allotype female, Aug. 3, 1921, Fern Lake, Estes Park, Colo. (P. W. Claassen, Cornell University Collection). Paratypes, 33 males, 34 females, Aug. 3, 1921, Fern Lake, Estes Park, Colo. (P. W. C.);

one male, Vesta Pass, Colo.; males and females, Boulder, Colo. (G. S. Dodds).

Alloperla albertensis, new species.

(Plate 22, figs. 6, 7.)

Length to tip of wings, male, 8.5-9 mm.; expanse, male, 15-16 mm. Length to tip of wings, female, 9.5-11 mm.; expanse, female, 17-19 mm.

General color of head and prothorax yellow with dark markings, abdomen dark brown, wings greenish hyaline. Similar to *coloradensis* and *lamba*. Head about as wide as prothorax, yellow, with dark marks at the ocelli (tending to form a V-shaped mark which connects the ocelli); lateral tubercles, frontal ridge and two spots on clypeus dark; a dark spot behind the eye; hind ocelli a little closer to the eyes than to each other; antennae yellow at base, blackish towards the tip.

Prothorax transversely oval, almost twice as wide as long; yellow, with a narrow blackish margin and with the rugosities blackish; legs yellowish, tarsi a little darker toward the tip. Wings yellowish to greenish hyaline; veins yellowish to light brown. Meso- and metanotum blackish.

Abdomen blackish; cerci yellow, somewhat infuscated towards the tip.

Male. Tenth abdominal tergite very broadly and deeply cleft, ninth tergite with a large sunken area; on the front margin of the ninth tergite a raised chitinous tubercle or process narrowly notched behind; supra-anal process recurved, somewhat concave above with a low median carina, somewhat spatulate at the tip, with a slender slightly upturned, spine-like, process which originates from the lower anterior part of the supra-anal process; penis with two finger-like membranous lobes at the tip and with two smaller lobes below, dorsally near the base of the penis two large, black, longitudinally striated leaf-like appendages; subanal lobes small, unmodified; ninth sternite produced and truncate behind.

Female. Subgenital plate of eighth abdominal sternite somewhat angulately produced, with the hind margin somewhat truncate and normally extending entirely across the ninth sternite or even partly onto ten. Plate is very similar to subgenital plate in *coloradensis* but not clothed with such stout hairs.

Distribution.—Holotype male, allotype female, July 6, 1923, Waterton Lakes, Alberta, Canada (J. McDunnough,

in Canadian Entomological Collection, Ottawa, Canada). Paratypes 6 males and 14 females, July 6-14, 1923, Waterton Lakes, Alberta, Canada (J. McDunnough).

Alloperla continua Banks.

(Plate 21, figs. 11, 12.)

1911. *Alloperla continua* Banks, Trans. Am. Ent. Soc., 37:336.

Length to tip of wings, male, 9.5-10.5 mm.; expanse, male, 16-18 mm., length to tip of wings, female, 11-12 mm.; expanse, female, 19-21 mm.

General color yellowish with a darker median stripe extending over head, prothorax and abdomen.

Head very little wider than prothorax, yellowish with a brown area over the ocellar triangle and over the clypeus; hind ocelli about as close to the eyes as to each other; antennae yellowish at base, darker towards the tip.

Prothorax transversely oval, wider than long; yellowish with a broad dark median stripe whose margins are not very clearly defined; disc of pronotum slightly rugose. Legs yellowish, tarsi darker. Wings greenish hyaline, veins greenish yellow.

Abdomen yellowish with a broad median dorsal dark stripe. Cerci yellowish, somewhat darker toward the tip.

Male. Anterior margin of ninth abdominal tergite with a raised transverse recurved tubercle; supra-anal process slightly emarginate behind; tenth tergite broadly cleft, ninth with a median depression in which the supra-anal process normally lies; subanal lobes small, unmodified; ninth sternite somewhat produced and truncate behind.

Female. Hind margin of eighth abdominal sternite produced into a broadly triangular subgenital plate which normally extends more than half way across the ninth tergite and is evenly rounded behind.

Distribution.—Type, female, No. 11349, June 17, San Gabriel Mts., Calif.; cotypes, one female, June 15, San Gabriel Mts., Calif.; one male, mountains near Claremont, Calif. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); one male, June 11, 1923, San Antonio Canyon, near Claremont, Calif. (Theresa Robinson); two males, three females, June 6-12, Keen Camp, Riverside Co., Calif. (E. P. Van Duzee).

The specimens from Keen Camp, Riverside Co., Calif., are darker in color but structurally they agree with the description.

Alloperla borealis Banks.

(Plate 14, fig. 1; plate 21, figs. 1, 2, 3.)

1895. *Chloroperla borealis* Banks, Trans. Amer. Ent. Soc., 22:313.
1907. *Alloperla borealis*, Banks, Can. Ent., 39:329.
1907. *Alloperla borealis* Banks, Cat. Neur., p. 13.

Length to tip of wings, male, 11-14 mm.; expanse, male, 20-27 mm.; length to tip of wings, female, 13-16 mm.; expanse, female, 24-29 mm.

The largest species of this genus.

General color yellowish brown with greenish wings.

Head very little wider than prothorax; yellow with a blackish V-shaped mark over the ocellar triangle, and with a brown or blackish mark in front of the anterior ocellus; lateral tubercles brown; a brownish spot behind the eye; hind ocelli a little closer to eyes than to each other; antennae fuscous, more yellowish at base.

Prothorax transversely oval, much wider than long; yellowish with a narrow blackish margin which extends around the entire pronotum; disc of pronotum with dark brown or blackish raised tubercles in the form of broken longitudinal lines, and leaving a broad median yellowish field which is about one-sixth as wide as the entire pronotum. Legs brown, tarsi darker. Wings greenish yellow; veins brown except subcosta which is yellowish; subcosta does not reach to the cord; five to seven costal crossveins before the end of subcosta and two to four beyond.

Abdomen brown; cerci yellowish, darker toward the tip.

Male. The anterior margin of the ninth abdominal tergite with a narrow, transverse, raised tubercle; supraanal process recurved, slender, tapering to a blunt point and normally with its tip under the tubercle of tergite nine, tenth tergite cleft and each side with long hairs; ninth tergite emarginate behind and clothed with long hairs; subanal lobes small, unmodified; ninth abdominal sternite somewhat produced and rather truncate behind.

Female. Hind margin of eighth abdominal sternite produced into a triangular subgenital plate with a broad squarish median notch at the tip; median area of eighth sternite raised into a circular ridge which tapers to a point at the notch of the subgenital plate.

Distribution.—Type, female, No. 11352, March 27, Olympia, Wash., Banks Coll., Mus. Comp. Zool., Cambridge, Mass.; two females April 29, two males May 9, one male May 1, one male May 2, Bon Accord, B. C.; two females, June 17, 1901, Banff, Alberta; one male, June 22, 1901, Port Renfrew, B. C. All these are in Banks Collection. 4 males, 4 females, July, 1923, Waterton Lakes, Al-

berta, Can., J. McDunnough; 3 females, July 4, 1908, Emerald Lake, Can. Rockies (J. C. Bradley); 1 female, July 19, 1908, Prairie Hills, Selkirk Mts., B. C. (J. C. B.); 1 female, Aug. 23, 1902, Laggan, B. C.; 1 female, March 1923, Terrace, B. C. (Mrs. W. W. Hippisley); 1 female, July 1-3, 1913, Maligne Lake, Alberta, Can.; 1 female, July 12-18, Carbonate to Prairie Hills, B. C. (J. C. B.); 1 female, June 24, 1920, Nanaimo, B. C. (E. C. Van Dyke); 1 male, April 11, 1898, Seattle, Wash. (Kincaid); 1 female, June 15, 1897, Olympia, Wash. (Kincaid); 2 males, 2 females, Aug. 15, 1908, Three Bros. Mts., Olympic Range, Wash. (J. C. B.); 3 females, May 15-19, Felton, St. Cruz Mts., Calif. (J. C. B.); 3 females, May 26, 1903, Fieldbrook, Calif. (H. S. Barber); 1 female, April 18, 1920, Beron Valley, Marin Co., Calif. (C. L. Cox); many males and females, Boulder, Colo. (G. S. Dodds); 1 male, August 27, South Park, Colo. (Oslar); 1 female, July 22, Geneva Park, Grant, Colo. (L. O. Jackson); 1 female, July 24, Geneva Park, Grant, Colo. (F. C. Jackson).

Alloperla fidelis Banks.

(Plate 21, figs. 8, 9, 10.)

1920. *Alloperla fidelis* Banks, Bull. Mus. Comp. Zool., 64:323.

Length to tip of wings, male, 9-11 mm.; expanse, male, 15-18 mm. Length to tip of wings, female, 11-14 mm.; expanse, female, 18-23 mm.

General color greenish yellow, pronotum with a narrow black border and with the rugosities usually brown.

Head slightly wider than prothorax; yellow with the clypeus slightly infuscated and the area back of the eyes sometimes a little darker; a black ring around the ocelli; lateral tubercles and frontal ridge also a little darker as a rule; hind ocelli very little closer to the eyes than to each other. Antennae yellow at base, fuscous beyond.

Prothorax transversely oval, nearly twice as wide as long; yellow with a narrow dark brown or blackish border, which in some specimens is restricted mostly to the lateral margins of the pronotum; surface moderately brown with longitudinal interrupted lines. Legs yellow, tarsi darker. Wings greenish hyaline, veins greenish. Abdomen yellow, with a broad median dark dorsal band. Cerci yellow, somewhat infuscated towards the tip.

Male. Near the anterior margin of the ninth abdominal tergite a transverse raised chitinous tubercle which is broadly emarginate at the tip; tenth tergite broadly bifid, with a median depressed area; supra-anal process re-

curved, narrowly spatulate, and narrower behind; subanal lobes small, unmodified; ninth sternite somewhat produced and truncate behind.

Female. Eighth abdominal sternite with a subgenital plate which is normally produced over about two-thirds of the ninth sternite, bilobed at the tip and between these two lobes usually another small median lobe; the median area of the plate with a bulge or ridge.

Distribution.—Type, female, No. 10823, June 24, 1915, Great Alpine Creek, Tahoe, Calif. (Banks Coll. Mus. Comp. Zool., Cambridge, Mass.). A number of males and females, July and Aug., 1923, Moraine Lake, Alberta, Canada (J. McDunnough); three females, July 6-12, 1923, Waterton Lakes, Alberta, Canada (J. McDunnough); one female, Aug. 18, 1916, Mont. Exp. Sta., Crazy Mts., Mont.; three females, one male, July 15, 1913, Gallatin Co., Mont.; one male, two females, July 12-18, 1908, Carbonate to Prairie Hills, B. C. (J. C. Bradley); two females 11-7, 1903, Ainsworth, B. C. (R. P. Currie); one male, three females, July 19, 1908, Prairie Hills, Selkirk Mts., B. C.

Very closely allied to *borealis*.

Alloperla spatulata, new species.

(Plate 21, figs. 13, 14.)

Length to tip of wings, male, 8.5-9 mm.; expanse, male, 15-16 mm.; length to tip of wings, female, 9-10 mm.; expanse, female, 18-21 mm.

General color pale yellow with broad black lateral margins on prothorax.

Head a little wider than prothorax, pale yellow with a little black around the ocelli and sometimes an infuscated area on the clypeus; hind ocelli just a little closer to the eyes than to each other; antennae yellowish at the base, becoming more infuscated towards the tip.

Prothorax transversely oval; wider than long; yellow, with broad dark brown or black lateral margins; this dark band extends around the angles and then tapers down to a point; surface slightly rugose; legs pale yellow, tarsi a little darker. Wings greenish hyaline; veins pale.

Abdomen yellowish with a broad median dark dorsal stripe. Setae pale yellow.

Male. Supra-anal process recurved, broadly spatulate, tenth tergite broadly cleft; ninth tergite with a deep median depression in which the supra-anal process normally

small transverse tubercle; subanal lobes small, unmodified.

Female. Hind margin of eighth abdominal sternite produced into a broadly rounded subgenital plate which normally extends about half way across the ninth sternite.

Holotype male, allotype female, June 11, 1923, San Antonio Canyon, near Claremont, Calif. (Theresa Robinson, in Cornell University Coll.).

Paratypes, three males, three females, from same locality.

Alloperla signata Banks.

(Plate 20, figs. 5, 6.)

1895. *Chloroperla signata* Banks, Trans. Am. Ent. Soc., 22:314.
1907. *Alloperla signata* Banks, Cat. Neur., p. 13.

Length to tip of wings, male, 7-8 mm.; expanse, male, 12-14 mm.; length to tip of wings, female, 8.5-11 mm.; expanse, female, 15-18 mm.

General color yellow with two blackish spots on the head and a broad blackish stripe on the prothorax.

Head slightly wider than prothorax; a black, somewhat triangular spot covering the ocellar triangle and a smaller triangular black spot in front of the ocellar triangle with its apex reaching almost to the front ocellus; remainder of head pale yellow; hind ocelli a little closer to the eyes than to each other; antennae yellowish at base, brown beyond; palpi brown, the apical segment very small, especially in the maxillary palpi.

Prothorax wider than long; disc transversely oval; yellow, usually with a broad median anchor-shaped blackish stripe, widened at both ends but more so in front than behind; sides of disc somewhat rugulose; legs yellowish, tarsi brownish, wings hyaline with a greenish yellow tinge; subcosta very faint, reaching to a point half way between the origin of the radial sector and the cord.

Abdomen brownish with a broad median interrupted dark stripe. Cerci yellow, darker toward the tip, especially the tips of the individual segments.

Male. Supra-anal lobe consists of a very short, brown, upturned, bluntly pointed process, minutely granulate; subanal lobes very small, triangular; ninth abdominal sternite prolonged beyond the tip of the abdomen; tenth abdominal segment partly cleft above and almost wholly withdrawn into segment nine; penis beset with stout hairs at the tip.

Female. Hind margin of eighth abdominal sternite

produced into a large rounded subgenital plate which normally reaches across the entire ninth sternite. In some of the females the hind margin of the plate is slightly emarginate while in others it is evenly rounded.

Distribution.—Type No. 11351, female, Pullman, Wash. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); one male, Pullman, Wash.; one male, one female, June 22, one male, six females, July 14-15, Florissant, Colo.; two males, June 8, Troublesome, Colo. (S. A. Rohwer). All these in Banks' Collection. Many males and females, Boulder, Colo. (G. S. Dodd); one female, June 1, Platte Cañon, Colo. (Dyar and Caudell).

Alloperla mediana Banks.

(Plate 21, figs. 4, 5.)

1911. *Alloperla mediana* Banks, Trans. Am. Ent. Soc., 37:336.

Length to tip of wings, male, 9-11; expanse, male, 16-19 mm.; length to tip of wings, female, 10-12.5 mm.; expanse, female, 18-22 mm.

General color pale yellow, with a more or less distinct, brown median stripe on pronotum and a dark stripe on abdomen.

Head a little wider than prothorax, pale yellow with a little blackish around the ocelli; hind ocelli a little closer to eyes than to each other; antennae yellow at base, dark brown or blackish toward the tip.

Prothorax transversely oval, half again as wide as long; yellow, usually with a broad median dark stripe which tends to fade out toward the margins; surface of pronotum not very rugose; legs yellow, tarsi a little darker at the tip; wings yellowish or greenish hyaline, veins yellowish.

Abdomen yellow, with a wide, dark, median, dorsal band. Cerci yellow, a little darker toward the tip.

Male. Tenth abdominal tergite broadly and deeply cleft; ninth tergite usually without a distinct median raised tubercle although in some of the males there appears to be a small tubercle present. Supra-anal process recurved, flattened laterally, at the base very broad (side view) with a slender, upturned process at the tip; subanal lobes small, unmodified; ninth sternite produced and almost evenly rounded behind.

Female. Subgenital plate of eighth sternite somewhat triangularly produced and behind broadly truncate; the plate often shows a median raised area.

This species is quite closely allied to *lateralis*.

Distribution.—Type, female, No. 11355, May, Black Mountains, N. C. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.). Paratypes, males and females, same locality (Banks Coll.); males and females, May 18, 1923, Ithaca, N. Y.; one male, one female, May 13, Clinton, N. Y. (P. B. Powell); one male, May 21, 1922, Enfield Falls, Ithaca, N. Y.; one male, May 27, 1922, Ithaca, N. Y.; one male, June 22, Niagara Falls, N. Y.; two females, July 11, 1917, Cranberry Lake, N. Y. (C. J. Drake); two males, one female, May 23, Newport, N. Y.; two females, June 28, Bashbish Falls, Mass. (C. W. Johnson); two males, May 26, Walpole, Mass. (C. W. Johnson); one male, one female, 1908, Millsville, N. S.

Alloperla lineosa Banks.

(Plate 20, figs. 10, 11.)

1918. *Alloperla lincosa* Banks, Bull. Mus. Comp. Zool., 62:7.

Length to tip of wings, male, 8 mm.; expanse, male, 13 mm.; length to tip of wings, female, 8.5-9 mm.; expanse, female, 14-15 mm.

General color pale yellow with a narrow median dark line on pronotum.

Head about as wide as prothorax; pale yellow; hind ocelli very little closer to the eyes than to each other; antennae pale yellow, slightly infuscated towards the tip.

Prothorax pale yellow with a median narrow dark line which follows the transverse groove somewhat in front and behind, so as to be in the form of an I; each side of the narrow black line the area is somewhat infuscated; the pronotum transversely oval, wider than long; surface only slightly rugose. Legs yellow, tarsi a little darker. Wings pale greenish hyaline with yellowish veins.

Abdomen yellow, with a median dark dorsal stripe. Cerci yellow.

Male. Tenth abdominal tergite broadly and deeply cleft; supra-anal lobe recurved, short, at the tip with a flattened chitinized knob; subanal lobes small, unmodified; ninth sternite somewhat produced and truncate behind.

Female. Eighth abdominal sternite with a large subgenital plate, which normally extends over segment nine and part of ten, very broadly emarginate behind.

Distribution.—Type, female, No. 10048, Aug. 20, 1914, Grant, Colo. (Banks' Coll., Mus. Comp. Zool., Cambridge, Mass.); one male, one female, July 20, 1921, Yellowstone National Park; eight females, Tolland, Colo. (G. S. Dodds).

Alloperla pilosa, new species.

(Plate 20, figs. 7, 8, 9.)

Length to tip of wings, male, 11-13 mm.; expanse, male, 18-21 mm.; length to tip of wings, female, 12-14 mm.; expanse, female, 20-23 mm.

General color pale yellow.

Head very little wider than prothorax, pale yellow; hind ocelli about as close to eyes as to each other; antennae yellow, infuscated towards the tip.

Prothorax transversely oval, wider than long, uniformly yellow, somewhat rugose. Legs yellow. Wings yellowish hyaline, veins yellowish.

Abdomen yellow with a broad, median, dorsal stripe. Cerci yellow.

Male. Tenth abdominal tergite deeply cleft; supra-anal lobe retractile, flattened dorso-ventrally; when fully expanded it shows a median brown chitinized rod surrounded by a membranous sheath to within a short distance of the tip; subanal lobes small, unmodified; ninth abdominal sternite produced and truncate behind. Ninth and tenth tergites with long hairs.

Female. Subgenital plate of eighth sternite broad at the base and then somewhat narrowed and triangularly produced so that the tip normally reaches almost entirely across the ninth sternite.

Distribution.—Holotype male, allotype female, Boulder, Colo. (G. S. Dodds, in Cornell University Collection).

Paratypes, three males and one female, same locality; one male, one female, Aug. 27, 1914, Platte Cañon, Colo. (Oslar).

Alloperla serrata, new species.

(Plate 20, figs. 12, 13.)

Length to tip of wings, male, 9-9.5 mm.; expanse, male, 16-17 mm.; length to tip of wings, female, 11 mm.; expanse, female, 18 mm.

General color greenish yellow with greenish wings.

Head a little wider than prothorax, greenish yellow; ocelli surrounded by a dark ring, more prominent in the hind ocelli; hind ocelli about as close to eyes as to each other; antennae yellow at base, infuscated towards the tip.

Prothorax wider than long, almost transversely oval, the angles very broadly rounded; greenish yellow; surface somewhat rugose. Legs yellow, wings greenish hyaline, veins greenish.

Abdomen yellowish. Cerci yellowish.

Male. Tenth abdominal tergite cleft; ninth tergite considerably humped; supra-anal process short, with a flattened rounded knob at the tip whose front margin is finely serrate; subanal lobes small, unmodified; ninth sternite produced and truncate behind.

Female. Median portion of the hind margin of the eighth abdominal sternite produced into a small triangular subgenital plate.

Distribution.—Holotype male, allotype female, Aug. 5, 1923, Moraine Lake, Alberta, Canada (J. McDunnough, in the Canadian Entomological Collection, Ottawa, Canada).

Paratypes, one male, two females, from the same locality; one male, July 7, Waterton Lakes, Alberta, Canada (J. McDunnough); two males, Aug. 9, 1905, Downie Creek, Selkirk, Mts., B. C. (J. C. Bradley).

Very similar to *A. nanina* Bks.

Alloperla imbecilla Say.

(Plate 20, figs. 1, 2.))

1823. *Sialis imbecilla* Say, West. Quart. Rept., p. 165.
1861. *Perla imbecilla* Hagen, Syn. Neurop. N. A., p. 31.
1906. *Alloperla imbecilla* Banks, Ent. News, 17:175.
1907. *Alloperla imbecilla* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 8-9 mm.; expanse, male, 13-15 mm.; length to tip of wings, female, 9.5 mm.; expanse, female, 16 mm.

General color pale yellowish green.

Head a little wider than prothorax; pale yellow; ocelli black; hind ocelli a little closer to eyes than to each other; antennae pale yellow.

Prothorax a little wider than long; almost oval, the front angles very broadly rounded, hind angles narrowly rounded; uniformly pale yellowish; slightly rugose. Legs pale yellow; wings pale hyaline, veins pale.

Abdomen pale yellowish, cerci pale yellow.

Male. Tenth abdominal tergite bifid; supra-anal process recurved, slender, gradually tapering to a point, normally reaching under the hind margin of the ninth tergite; subanal lobes small, unmodified; ninth abdominal sternite produced and rounded behind.

Female. Hind margin of eighth abdominal sternite with the median portion produced into a narrow tongue-like subgenital plate.

Distribution.—Burton, Ga., May 21, 1911 (J. C. Bradley); Newfield, N. Y., June 5; Sport Island, Sacandaga R.,

N. Y., June 17; Alcohol Brook, Adirondack Lodge, N. Y., July 1, 1923; Mt. Desert, Me., June 10, 1921 (C. W. Johnson).

Alloperla nanina Banks.

(Plate 20, figs. 3, 4.)

1911. *Alloperla nanina* Banks, Trans. Amer. Ent. Soc., 37:366.

Length to tip of wings, male, 7.5-9.5 mm.; expanse, male, 13-16 mm.; length to tip of wings, female, 9-11 mm.; expanse, female, 15-19 mm.

General color pale yellow with greenish wings.

Head a little wider than prothorax, yellow or greenish; hind ocelli closer to the eyes than to each other; antennae yellow at base, darker toward the tip.

Prothorax transversely oval, wider than long; yellow with the median portion sometimes a little darker; surface very slightly rugose. Legs yellowish, tarsi darker towards the tip. Wings greenish hyaline; veins greenish yellow.

Abdomen pale greenish, without a dark dorsal stripe. Cerci yellowish, a little darker towards the tip.

Male. Tenth abdominal tergite cleft; ninth tergite pushed forward so as to appear deeply emarginate behind; supra-anal process recurved, flattened dorso-ventrally, the apical margin serrate or closely beset with spines and at the tip and above just before the tip with a bunch of hairs; subanal lobes small, unmodified; ninth sternite produced and somewhat truncate behind.

Female. Hind margin of eighth abdominal sternite centrally produced into a narrow tongue-like sub-genital plate, which normally reaches entirely across the ninth sternite.

Distribution.—Type, female, No. 11343, May, Black Mts., N. C. (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.); paratypes, two males, four females, May, Black Mts., N. C. (Banks Coll.). Many males and females, May, June and July, Ithaca, N. Y.; one male, July 5, 1923, Oxford, N. Y.; males and females, July 1-2, 1923, West Branch, Ausable River, Essex Co., N. Y.; two males, two females, July 2, 1923, Elizabethtown, N. Y.; one male, one female, July 1, 1923, Adirondack Lodge, N. Y.; one male, May 18-26, 1911, Clayton, Ga. (J. C. Bradley); many males and females, June 13-26, 1913, Truro, N. S. (R. Matheson).

There seems to be some variation in the structure of the small chitinized tip of the supra-anal process of the male. In some of the males the tip is rounded and

smooth, in others the tip is sharply pointed and smooth, while in still others there is a small semi-membranous, bilobed process at the tip of the supra-anal process. All of these specimens agree in coloring, in size and in other structural characters, and we do not feel that the slight differences in structure at the tip of the supra-anal process justify separating them into species.

Genus CHLOROPERLA Newman.

1836. *Chloroperla* Newman, Ent. Mag., 3:50.
1841. *Isopteryx* Pictet Ins. Neurop., p. 301.
1861. *Isopteryx* Hagen, Syn. N. A., p. 31.
1892. *Isopteryx* Banks, Cat. Neurop., p. 342.
1907. *Chloroperla* Banks, Cat. Neurop., p. 13.
1909. *Chloroperla* Enderlein, Zool. Anz., 34:388.

Small pale greenish species 6-9 mm. long. In life bright green. Hind wings without a folded anal area. Closely allied to Alloperla Banks.

Head a little wider than prothorax; pale yellowish green; three small black ocelli; hind ocelli closer to the eyes than to each other. Antennae pale at base, infuscated towards the tip. Apical segment of palpi slender and small.

Prothorax transversely oval, uniformly pale or greenish; subrugulose. Legs pale, tips of tarsi blackish; first and second tarsal segments very short, subequal, third tarsal segment long. Wings greenish hyaline, veins pale; subcosta ends much before the cord; several costal crossveins before end of subcosta and one beyond; radial sector with two branches in the forewing and one in the hind wing; second cubital vein of forewing short and downcurved; second anal vein of forewing branched; hind wing without a folded anal field.

Abdomen pale. Caudal setae pale, short, with about 8 segments.

Male. Ninth abdominal sternite much produced and rounded behind; tenth abdominal tergite partly cleft; supra-anal process composed of a short upturned triangular lobe; subanal lobes small, unmodified.

Female. Hind margin of eighth abdominal sternite produced into a rounded subgenital plate.

Genotype, *Chloroperla apicalis* Newman, of Europe.

The genus is represented by only one species that is generally distributed over North America.

Chloroperla cydippe Newman.

(Plate 14, fig. 6; plate 23, figs. 1-3.)

1839. *Chloroperla cydippe* Newman, Mag. Nat. Hist., 3:88.
1842. *Isopteryx cydippe* Pictet, Inc. Neurop., p. 317.
1852. *Perla cydippe* Walker, Cat., p. 168.
1861. *Isopteryx cydippe* Hagen, Syn. Neurop. N. A., p. 31.
1892. *Isopteryx cydippe* Banks, Cat., p. 342.
1904. *Isopteryx cydippe* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Chloroperla cydippe* Banks, Cat. Neurop., p. 12.
1895. *Chloroperla brevis* Banks, Trans. Am. Ent. Soc., 22:314.
1907. *Alloperla brevis* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 6.5-7.5 mm.; female, 8-9 mm.; expanse, male, 12-13 mm.; female, 14-16 mm.

General color yellowish green, bright green in life.

Head a little wider than prothorax; pale yellowish green; three small black ocelli, the hind ocelli closer to the eyes than to each other. Antennae pale at base, infuscated towards the tip. Apical segment of palpi short.

Prothorax transversely oval; angles much rounded; uniformly pale; subrugulose. Legs pale; tips of tarsi blackish. Wings greenish hyaline, veins pale; subcosta ends much before the cord; several crossveins before the end of subcosta and one beyond; second anal vein of forewing branched; second cubital vein of forewing short, downcurved and originating opposite the tip of first anal vein; hind wing without a folded anal field; radial sector with two branches in forewing, unbranched in hind wing.

Abdomen pale. Caudal setae pale, short, with about 8 segments.

Male. Ninth abdominal sternite much produced and evenly rounded behind; tenth abdominal tergite partly cleft; supra-anal process modified into a very short, somewhat triangular, recurved process; subanal lobes small, unmodified.

Female. Hind margin of eighth abdominal sternite produced into a broad, rounded subgenital plate which normally extends over most of the ninth sternite.

Distribution.—Georgia, Clayton, May 18-23, 1911 (J. C. Bradley); Burton, May 21, 1909. North Carolina. Maryland, Beltsville, May 2, 1915 (W. L. McAtee). Maine, Echo Lake, Mt. Desert, July 12 (C. W. Johnson); Orono, May. New Hampshire, Durham. Pennsylvania, Harrisburg, May 9-15; Montgomery Co., May 26. New York, Ithaca, May-July; Newfield; Sport Island, Sacandaga R., June 17 (C. P. Alexander); Hamburg, July, 1908. Wisconsin, Polk Co., July (Baker). Nevada, Reno, 1878 (Morrison).

MANITOBA, Aweme, July 1, 1907 (N. Criddle). NOVA SCOTIA, Truro, July 4, 1913 (R. Matheson).

Genus PARAPERLA Banks.

1906. *Paraperla* Banks, Can. Ent., 38:222.
1907. *Paraperla* Banks, Cat. Neurop., p. 12.
1909. *Paraperla* Enderlein, Zool. Anz., 34:390.

Brown medium sized stoneflies, 11-17 mm. in length; with a long head, a transversely oval prothorax and with second anal vein of forewing branched.

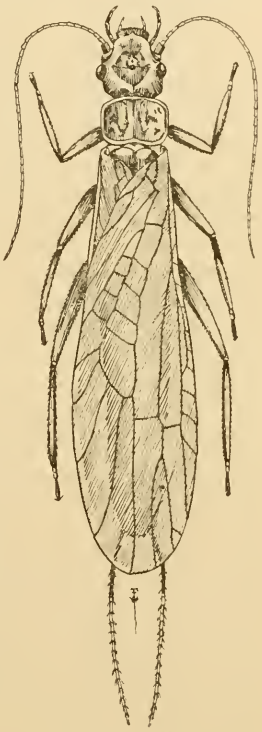

Fig. 16. *Paraperla frontalis* Bks.

Head unusually long, a little wider than prothorax; length of head back of eyes at least as great as the length of the eye; ocellar triangle covered by a brown wash which is bounded behind by the occipital sutures; three small ocelli; the hind ocelli a little closer to each other than to the eyes.

Pronotum transversely oval; wider than long; all angles much rounded; a narrow blackish groove runs all around the margin; surface slightly rugose. Legs brown, tarsi blackish, first and second tarsal segments very short, sub-equal, third tarsal segment at least twice as long as one and two combined. Wings subhyaline; subcosta ends much before the cord; several costal crossveins before the end of subcosta as well as beyond; second anal vein of forewing branched; anal field of hind wings large; stem of Rs-M in hind wing very long.

Abdomen brown; cerci long, with at least 18 segments.

Male. Ninth sternite not much produced; tenth tergite cleft; supra-anal process upturned and largely membranous; subanal lobes broadly triangular, not modified into recurved hooks.

Female. Subgenital plate large, much produced and notched in the middle.

Distribution.—Western States.

Genotype, *Perlinella frontalis* Banks.

This genus is represented by only one species. By its long head and transversely oval prothorax, as well as by other characters it is allied to *Kathroperla* Bks.

Paraperla frontalis Banks.

(Plate 15, fig. 8; plate 23, figs. 4, 5, 6.)

1902. *Perlinella frontalis* Banks, Can. Ent., 34:123.
1907. *Paraperla frontalis* Banks, Can. Ent., 39:328.
1907. *Paraperla frontalis* Banks, Cat. Neurop., p. 12.

Length to tip of wings, male, 11-14 mm.; female, 13-17 mm. Expanse, male, 20-25; mm.; female, 22-28 mm.

General color brown.

Head slightly wider than prothorax; yellowish with a darker spot over the ocellar triangle; bounded behind by the occipital sutures and enclosing the large flat lateral tubercles, extending forward nearly to the front margin of clypeus; frontal ridge shaped like a German capital V; the area just back of eyes and the posterior border of the head brown; length of head behind the eyes at least as long as the length of the eye; the ocelli form an almost equilateral triangle, the hind ocelli being a little closer to each other than to the eyes; apical segment of maxillary palpi small; antennae dark brown.

Prothorax transversely oval, wider than long, somewhat narrowed behind; all angles very broadly rounded; brown with a lighter area on each side and with the rugosities darker brown; a narrow median longitudinal black line and a narrow black line within the groove which extends around the entire margin of the pronotum. Legs brown; femora with a narrow transverse black band at the tip and tibiae with a black spot at the proximal end; tarsi blackish, first and second segments short, subequal, third segment at least twice as long as one and two combined. Wings subhyaline, veins heavy, brown; subcosta ends much before the cord; four to six costal crossveins before the end of subcosta and three to four beyond; radial sector with two or three branches; second anal vein of forewing forked; hind wing with a large anal field, with several cubital crossveins; basal stem of Rs-M in hind wing very long.

Abdomen brown. Setae yellowish brown to dark brown; long, with at least 18 segments; middle segments about four times as long as wide.

Male. Ninth abdominal sternite slightly produced and evenly rounded behind; tenth tergite cleft; supra-anal process upturned, largely membranous and composed of a

median fleshy lobe with a shorter lobe each side; basally the supra-anal process is attached to a black chitinous base from which originate two rearward divergent, dark chitinous bands which curve downward at the tip; sub-anal lobes broadly triangular and not developed into recurved hamules.

Female. Subgenital plate large, normally nearly covering the ninth sternite, triangularly notched in the middle.

Distribution.—Type, male, May 30, 1892, Beulah, N. Mex. (Banks' Collection, Museum of Comparative Zoology, Cambridge, Mass.). In Banks' collection is also a female, July 11, Beulah, N. Mex. One male, one female, Reno, Nev., 1878 (Morrison); one male, one female, Boulder, Colo. (G. S. Dodds); two females, May 2, Logan, Utah; one male, May 29, 1909, Salt Lake City, Utah (E. G. Titus); one female, August, 1913, Beaver Creek, Mont. (S. J. Hunter); one female, Aug. 2, 1915, Rattlesnake Cr., Tulare Co., Calif., 9,000 ft.; one female, May 8, 1921, Steven's Creek Gorge, Santa Clara Co., Calif.

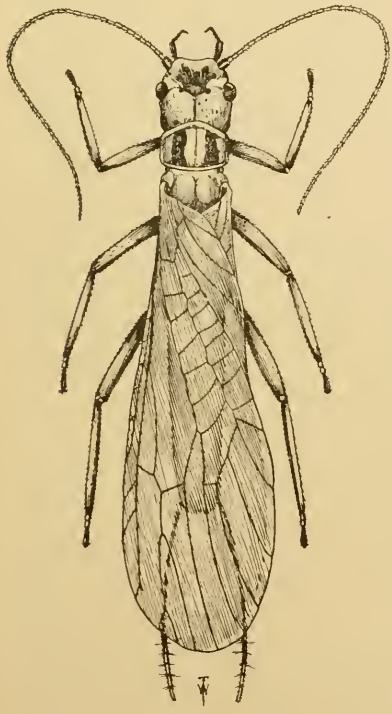

Fig. 17. *Kathroperla perdita* Bks.

Genus KATHROPERLA Banks.

1920. *Kathroperla* Banks, Bull. Mus. Comp. Zool., 64:315.

Length, 20-24 mm.; brown and yellow markings, transversely oval pronotum with broadly rounded corners; elongate head.

Head very long; about as wide as prothorax; compound eyes small; three ocelli, forming an equilateral triangle; hind ocelli about as close to eyes as to each other; the length of head behind the eyes equals at least half the length of entire head; antennae dark, first and second segments of about equal length; palpi dark, slender.

Prothorax wider than long, transversely oval, with a yellow median stripe and with some yel-

low on the sides; surface moderately rugose; front and hind margin convex; angles broadly rounded; a depressed groove extends all around the margin. Legs dark brown; apical tarsal segment longer than the other two segments combined; first segment longer than second. Wings subhyaline or lightly infuscated; veins dark, not heavy; venation as in Pl. 15, fig. 6.

Abdomen brown; cerci or tails dark, hairy, reaching nearly to tip of wings; basal segments short, segments beyond middle about three times as long as wide.

Male. Ninth abdominal sternite produced and evenly rounded behind and bearing a rounded, chitinized, knob-like appendage; tenth tergite partly cleft; supra-anal process broad and short, partly membranous; subanal lobes unmodified.

Female. Subgenital plate produced and emarginate in the middle.

Genotype, *K. perdita* Banks, the sole known species.

Kathroperla perdita Banks.

(Plate 15, fig. 6; plate 23, figs. 7, 8.)

1920. *Kathroperla perdita* Banks, Bull. Mus. Comp. Zool., 64:315.

Length to tip of wings, male 20 mm.; expanse, male, 35 mm.; length to tip of wings, female, 23-24 mm.; expanse, female, 38-40 mm.

General color dark brown with yellow on head and prothorax.

Head very long, about as long as wide; the distance from the hind margin of the eyes to the pronotum much greater than the distance from the front margin of the eyes to the anterior margin of the head. Color dark brown with yellow in front of the ocellar triangle and extending back on the outer margin and along a ridge to the posterior ocelli (in the specimen from California the head is largely yellow except for a dark spot over the ocellar triangle and a black margin behind the eyes); tubercles very weak; no frontal ridge, two raised spots in front and each side of the front ocellus; eyes very small; ocelli form an equilateral triangle, the hind ocelli about as close to the eyes as to each other. Antennae dark brown, the second segment almost as long as first; palpi dark brown.

Prothorax about as wide as head; transversely oval, much wider than long; blackish brown with a median yellow stripe and a yellowish mark on the lateral margins; front and hind margins rounded, sides convex or much

rounded; angles much rounded; rugosities not very strong; the groove in front and behind faintly continuous on the outer margins; meso- and metathorax dark brown with a pale spot in front and pale in the middle above. Legs, dark brown; femora with a narrow transverse black band at distal ends; first tarsal segment about twice as long as second; third segment longer than one and two together. Wings subhyaline; area between costa and radius beyond end of subcosta infuscated. Veins, including costa, dark brown.

Abdomen dark brown, hairy, dark underneath. Cerci or tails blackish brown, first segment about twice as long as wide, the next few segments wider than long; segments beyond the middle about three times as long as wide, hairy.

Male. Ninth abdominal sternite produced, evenly rounded behind and bearing a ventral appendage in the form of a rounded knob; from the base of the ventral appendage originate two divergent lines, the area between these lines somewhat depressed; tenth tergite partly cleft, the hind margin each side of the middle beset with small pegs; supra-anal process short, broad, upturned, with a chitinized rim connected in the middle by a short chitinous, transverse piece: remainder of supra-anal process membranous; subanal lobes triangular, unmodified.

Female. Ventral plate very broad and triangularly produced across segment nine, notched in the middle.

Distribution.—Type, female, 10819, Kaslo, British Columbia, April 24 (Banks' Collection M. C. Z., Cambridge, Mass.). One female, Redwood Canyon, Marin Co., Calif., V-17-08 (E. C. Van Dyke); one female, "Sitcha"; one male, Terrace, B. C. (Mrs. W. W. Hippesley).

Genus NEOPERLA Needham.

1892. *Pseudoperla* Banks, Trans. Am. Ent. Soc., 19:322 (preoc.).
1905. *Neoperla* Needham, Proc. Biol. Soc. Wash., 18:108.
1907. *Neoperla* Banks, Cat. Neurop., p. 12.
1909. *Neoperla* Klapalek, Wien. Ent. Zeit., 28:216.
1909. *Ochthopetina* Enderlein, Stett. Ent. Zeit., 70:324.
1923. *Neoperla* Klapalek, Coll. Zool de Selys, IV, 2:125.

Medium sized brownish species, 10-18 mm. in length, with two ocelli placed very close to each other; wings lightly to heavily infuscated.

Head wider than prothorax, yellowish to brown; two large ocelli, less than two diameters apart, surrounded by a black ring or else both ocelli situated upon a black spot.

Prothorax wider than long, narrowed behind; front

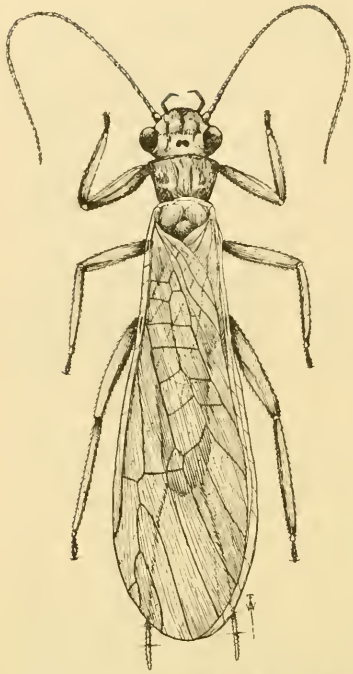

Fig. 18. *Neoperla clymene* Newm.

angles acute, hind angles somewhat rounded; surface quite rugose. Legs brownish; first and second tarsal segments very short, subequal; third segment much longer than one and two combined. Wings lightly to heavily infuscated; a number of costal crossveins before the end of the cord and from one to four beyond; subcosta does not reach to the cord; anal area of hind wings large; second anal vein of hind wing bent towards the third vein and usually connected to the third vein by a crossvein. Tails long and slender.

Male. Hind margin of seventh abdominal tergite with a raised rearward pointing process; tenth tergite with two incurved, bluntly pointed processes which originate at the base of the cerci and almost meet at the tips and just before the tips these processes bear a slender, finger-like process which is directed forward obliquely over the abdomen; subanal lobes and supra-anal process unmodified.

Female. Eighth abdominal sternite unmodified or slightly produced into a subgenital plate.

Distribution.—North America, Asia and Africa.

Neoperla clymene Newman.

(Plate 24, figs. 1-5, and text fig. 5.)

1839. *Chloroperla clymene* Newman, Am. Mag. Nat. Hist., 3:87.
1842. *Perla clymene* Pictet, Ins. Neurop., p. 283.
1852. *Perla clymene* Walker, Cat. Neurop., p. 167.
1861. *Perla clymene* Hagen, Syn. Neurop., N. A., p. 29.
1863. *Perla clymene* Hagen, Stett. Ent. Zeit., 28:217.
1892. *Perla clymene* Banks, Cat., p. 342.
1907. *Neoperla clymene* Banks, Cat., p. 12.
1909. *Neoperla clymene* Klapalek, Wien. Ent. Zeit., 28:217.
1909. *Neoperla clymene* Enderlein, Zool. Anz., 34:390.
1842. *Perla occipitalis* Pictet, Ins. Neur., p. 254.

1852. *Perla occipitalis* Walker, Cat. Neurop., p. 160.
1861. *Perla occipitalis* Hagen, Syn. Neurop., N. A., p. 27.
1862. *Perla occipitalis* Walsh, Proc. Acad. Nat. Sci. Phil., p. 365.
1892. *Perla occipitalis* Banks, Cat. Neurop., p. 342.
1894. *Pseudoperla occipitalis* Banks, Ent. News., 5:178.
1904. *Pseudoperla occipitalis* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Pseudoperla occipitalis* Tucker, Kan. Univ. Sci. Bull., 4:78.
1907. *Neoperla occipitalis* Banks, Cat. Neurop., p. 12.
1908. *Neoperla occipitalis* Banks, Proc. Ent. Soc. Wash., 9:150.
1909. *Neoperla occipitalis* Klapalek, Wien. Ent. Zeit., 28:218.

Length to tip of wings, male 10-14 mm.; expanse, male, 17-24 mm.; length to tip of wings, female, 12-18 mm.; expanse, female, 21-33 mm.

General color yellow varied with brown, with lightly to heavily infuscated wings.

Head a little wider than prothorax; yellowish with a black spot over the ocelli and sometimes with an infuscated spot on the labrum. (In some specimens the black spot over the ocelli is not connected between the ocelli so that each ocellus is surrounded by a black ring) ; ocelli two, large, less than two diameters distant from each other; antennae brown to blackish, somewhat lighter at the base.

Prothorax brown, sometimes lighter in the median area; considerably narrowed behind, wider than long; front angles acute, hind angles rounded; surface quite rugose; the grooves on the front and hind margin blackish. Legs yellowish to brown, externally darker; first and second tarsal segments very short, subequal, third tarsal segment much longer than one and two combined. Wings lightly to heavily infuscated; veins brown except costa and subcosta, which are usually yellow, especially in those specimens having heavily infuscated wings; subcosta ends before the cord; 8-14 costal crossveins before the end of subcosta and 2-4 beyond; radial sector usually three branched; several cubital crossveins in the hind wing; second anal vein of hind wing usually connected to third vein by a crossvein.

Abdomen and cerci yellowish.

Male. Hind margin of seventh abdominal tergite with a median raised, chitinous process directed backward with prickles on the tip and behind; eighth tergite with a median raised rounded knob beset with prickles; ninth tergite with a small median and lateral raised area, all beset with prickles; tenth tergite with incurved processes, originating at the base of the cerci, and almost meeting on the mid-dorsal line of the tenth tergite. They are evenly rounded and finely spinulose at the tip; a little distance before the tip these incurved processes bear a

long slender finger-like process which is directed forward over the ninth tergite. Subanal lobes and supra-anal process small, unmodified; ninth abdominal sternite somewhat produced and rounded behind.

Female. Hind margin of eighth abdominal sternite not produced or very slightly produced in the middle.

Distribution.—Generally distributed east of the Rocky Mountains. Originally described from Georgia.

Pennsylvania, Ohio Pyle, July 22, 1905; Harrisburg, July 7.

Maryland, Plummers Is., June 19, 1903; Washington, D. C., Aug.

New Jersey, Westfield, June 25.

Maine, Ft. Kent, July 7 (C. W. Johnson).

Vermont, Dummerston, July 14, 1908 (C. W. Johnson).

Connecticut, Middletown, June 17, 1909 (C. W. Johnson).

New York, Ithaca, June to Sept.; Ft. Montgomery, July 26; Westfalls, July 15, 1901; Ancram, June 11, 1919; Lake Charlotte, June 26, 1920; St. Martinsburg, July 4, 1923 (C. K. Sibley).

Ohio, Columbus, June (C. J. Drake).

Michigan, Ann Arbor, July 16, 1901.

Illinois, Ottawa, Aug. 6 (W. E. Howard); Bloomington, June 21, 1894 (C. C. Adams).

Iowa, Keokuk, June (Schaffer).

Missouri, Columbus, July 17, Aug. 6-8 (C. R. Crosby).

Minnesota, Ramsey Co., Univ. Farm, July 10, 1921 (W. E. Hoffman).

Kansas, Lawrence, June to July; Fredonia, July 11, 1919 (Fred Butcher); Delphos, June, 1900; Riley Co., July 5 to 26; Osborne Co., July 5; Cherokee Co., 1915 (R. H. Beamer); Sumner Co., 1915 (R. H. Beamer); Manhattan, July 15, 1922 (R. C. Smith).

Tennessee, Knoxville, June 5, June 24.

Mississippi, Agr. College (H. E. Weed).

Texas, Austin.

Arizona, one female, no data.

Nova Scotia, Truro, Aug. 7, 1913 (R. Matheson).

There is considerable variation in size and color within this species, but the genital and other structural characters agree so well that we are able to recognize in our fauna only one species within this genus.

CLIOPERLA, new genus.

Stoneflies of moderate or small size, having a yellow dorsal stripe upon the prothorax, yellowish areas around the eyes and rear of the head. The genital hooks of the male when developed originate from the subanal lobes and are less slender than in Isoperla. Ventral lobe on male abdomen when developed is present on segment 8. The radial sector forks far beyond the cord and in the hind wing there are a few intercubital crossveins. The cubito-anal crossvein of the fore wing is close to the apex of the anal cell.

Genotype, *Isogenus clio* Newman.

Key to the Species.

Males.

1. No ventral lobe on abdominal segment 8 ---- *cbria*
   Ventral lobe present ---------- 2
2. Ventral lobe very weakly developed ---- *gravitans*
   Ventral lobe well developed, conspicuous ------- 3
3. Subanal lobes developed as genital hooks --- *similis*
   Subanal lobes not developed as genital hooks -- *clio*

Unknown are *sobria*, *slossonae*, *annecta* and *marmorata*.

Females.

1. Subgenital plate with a deep median cleft -- *sobria*
   Subgenital plate with hind margin entire ------ 2
2. Subgenital plate produced posteriorly well across the 9th sternite ---------- 3
   Subgenital plate scarcely prolonged posteriorly -- 5
3. Area of ocellar triangle black—eastern -------- 4
   Area of ocellar triangle with a median yellow spot —western ---------- *cbria*
4. Subgenital plate very broadly produced and evenly rounded ---------- *slossonae*
   Subgenital plate truncate, not evenly rounded --- ---------- *similis*
5. Wing membrane tinted with brown ---- *marmorata*
   Wing membrane subhyaline ---------- 5
6. Vein Rs 2-branched; in hind wing the fusion of Rs and M extends more than half the length of the disc ---------- *annecta*
   Vein Rs 3-branched; in the hind wing the fusion of Rs and M is much less than half the length of the disc ---------- *clio*

Unknown, *C. gravitans* sp. nov.

Cloperla similis Hagen.

1861. *Perla similis* Hagen, Synops. Neur. N. A., p. 26.
1907. *Perla similis* Banks, Cat. Neurop., p. 12.
1908. *Perla similis* Banks, Ent. Soc. Wash., 9:151.

Length to wing tips, male, 12 mm., female, 13-15 mm.; expanse, male, 23 mm., female, 24-28 mm.

Color brown and yellow with black antennae and yellow-tipped abdomen. Head yellow around the eyes and beneath and narrowly across the occiput, and paler on the M-mark across the frons, but otherwise blackish dorsally. Palpi dusky.

Prothorax much wider than long with bright yellow middorsal stripe, that is variable of width and form, and that is narrowly grooved down its center. This stripe is continued halfway along both meso- and metathorax. Legs dusky. Wings subhyaline with pale brown veins, faintly tinged with yellow at base and at stigma.

Abdomen brown, the last two segments yellow. Tail brownish, at base yellow.

Male. Abdominal segments normal to the 8th, which bears a low, broad lobe at its apex, ventrally set off at its base by a curving groove that runs out at the side margins; lobe and sides both yellow. Segment 9 all yellow, abruptly elongated in its lower half into a broadly oval upturned subgenital scoop with a wide obtuse apex. Segment 10 on dorsal apical margin very slightly convex and entire. No genital hooks visible without dissection. Tails thinly hairy, yellow at base.

Female. Subgenital plate a short broadly rounded lobe occupying the middle half of the border of the 8th sternite and overlapping a very little upon the 9th; the edge in dried specimens appears to be rather evenly truncated.

Distribution.—Eastern States: Pennsylvania and Maryland (P. R. Uhler); Mt. Washington, N. H., Sept. 14, 1907 (Glover M. Allen); Moore's Brook near Ithaca, May 13, 1922 (C. K. Sibley); Ringwood Hollow near Ellis, N. Y., April 17, 1922 (P. W. Claassen).

Cloperla gravitans, new species.

(Plate 11, fig. 6; plate 25, figs. 7, 8.)

Length to wing tips, male, 18 mm.; expanse, 32 mm.

Color black varied with yellow. Head black with a pair of irregular longitudinal stripes conjoined across the front ocellus and less broadly behind the epicranial suture, separated in front by a narrow yellow median line for the entire length of the clypeus. Eyes narrowly

ringed with yellow that is confluent with the dorsal stripe. Hind angles of head black externally, the M-mark across the frons is polished, slender, and near its outer end are the minute roundish frontal tubercles. Antennae and palpi brown.

Prothorax one-half wider than long, quadrangular with wide submarginal grooves across both front and rear. Color brown, with a wide and conspicuous parallel sided median yellow stripe. There is a faint continuation of this stripe on the front of the mesothorax. Embossed markings of sides of the prothoracic disc are rather fine vermiculate, polished brown. The angles have a faint suggestion of yellow color. Legs brown beyond the yellow short basal segments except for a conspicuous yellow knee cap, covering an eighth of the tips of the femora. Wings subhyaline with strong brown veins.

Abdomen blackish, genital parts and environs yellowish. Tails brown, paler at base.

Male. Abdominal segments normal to the 8th, which is very slightly modified on the ventral side, a crescentic apical area being yellowish and somewhat delimited basally by a shallow groove. The ninth segment is prolonged ventrally into a low broad subgenital scoop with the usual upcurvature of the apex. The tenth segment is inclosed in the ninth below, entire above, and broadly convex in the middle. Genital hooks spring from the subanal lobes, short, recurved and clawlike.

One male specimen from Olympia, Wash., June, 1898 (Cornell University Collection).

Clioperla clio Newman.

(Plate 12, fig. 3; plate 25, figs. 4, 5, 6.)

1833. *Isogenus clio* Newman, Mag. Nat. Hist., 3:86.
1852. *Isogenus clio* Walker, Cat. Neur. Ins., p. 146.
1861. *Perla clio* Hagen, Syn. Neur. N. A., p. 19.
1863. *Perla clio* Hagen, Stett. Ent. Zeit., 24:371.
1907. *Isogenus clio* Banks, Cat. Neurop., p. 11.
1912. *Isogenus clio* Klap., Coll. Selys, 4:60.

Length of male to wing tips, 17 mm., expanse, 28 mm.

Length of female to wing tips, 20 mm.; expanse, 34 mm.; antennae, 10 mm.

Color fuscous varied with yellow. Head yellow above with a big blackish short-armed X-mark on the crown, the crossing of the X between the ocelli, the projecting arms short, especially rearward, the forward arms extending toward the bases of the antenna. A heavy yellow V-mark in front of the middle ocellus, the V opening

forward, divides the black of the front of the head. Eyes surrounded by yellow, a black spot caps the hind angles of the head. Antennae fuscous; palpi pale; tubercles angular, subcarinate, obscure, black.

Prothorax nearly twice as wide as long, brown with yellow mid-dorsal stripe that widens to its ends. Embossed markings in the brown of the disc coarse and obscure; sides parallel. Legs brown. Fore wings and costal strip of hind wings brownish with darker veins.

Abdomen pale above, fuscous at sides and beneath.

Male. Pale above and below with brown sides, the pale color of the dorsum cut obliquely at sides and extended downward farthest at apex of each segment. Segments normal to the 8th which is a little enlarged ventrally, and bears across its mid-ventral apical margin a long, bow-shaped or slightly crescentric callosity in the middle line of which is a small rounded lobelike projection. Segment 9 is very much enlarged and prolonged ventrally into an ovate broadly rounded subgenital scoop that doubles the length of the segment and includes segment 10 and the genitalia. Scoop yellow, washed with brown at sides basally.

Female. The subgenital plate is scarcely modified from the straight cut sternite of the 8th abdominal segment being set off by obscure folds, its edge but little elongated and outcurving and not strongly chitinized. The yellow of the under surface of segments 9 and 10 is invaded midlaterally by the brown of the sides and there are paired isolated touches of brown on the sides of the preceding segments.

Distribution.—Raleigh, N. C., March 22, 1906 (C. S. Brimley); Elkhart, Ind., June, 1907 (R. Weith).

Cloperla annecta, new species.

(Plate 12, fig. 5.)

Length to tip of wings, female, 15 mm.; expanse, 26 mm.

Color black and reddish orange. Top of head black surrounded by orange, broadly at the hind angles, narrowly in front, with sometimes a round interocellar spot, and usually another transverse one in the middle of the shining M-mark on the frons. Antennae black on basal segment, then yellow on the basal fourth of the flagellum, then blackish. Palpi blackish.

Prothorax about twice as wide as long with the usual mid-dorsal yellow stripe traversed by a sharp narrow

median groove. There are faint touches of orange at the front angles and farther back upon the side margins, and sometimes also in the midst of the black each side of the disc. Embossed markings subobsolete. Legs yellowish at the sides and across the apex of the femora, elsewhere brown, darkening on the tarsi. Coxae and trochanters yellow. Wings hyaline, with a faint suggestion of yellowish in the costal space and with very heavy black veins. A large closed cell occupies about half the space between veins R and M beyond the cord.

Abdomen blackish above except for the apices of the 9th and 10th segments which are yellow. There are also narrowed yellow lines on lateral and apical carinae of some of the preceding segments. Tails blackish, thinly clad with short yellowish pubescence.

Male, unknown.

Female. Subgenital plate very low and broad, about as wide as the abdomen, extended beneath half or more of segment 9, and broadly rounded on its free border, with a black spot each side at its base. Segments 9 and 10 yellow beneath with a conspicuous round black spot at each side.

Distribution.—Black Rock, Clinton Co., N. Y., June 21, 1910 (C. R. Crosby); Quebec (Geo. Maheux).

Holotype female in Cornell University Collection.

Clioperla ebria Hagen.

(Plate 25, figs. 1, 2, 3.)

1875. *Perla ebria* Hagen, Bull. Geol. Surv. Terr., p. 577.
1907. *Isoperla ebria* Banks, Cat. Neurop., p. 13.

Length to wing tips, male, 12-14 mm.; female, 15-17 mm. Expanse, male, 20-24 mm.; female, 25-29 mm.

Color brownish varied with yellow. Head brown in the middle above and on the hind angles at the sides behind the eyes; three yellowish spots in area between the eyes, one the crown spot between the ocelli, the others outside the lateral ocelli; three pale spots across the frons, one before the median ocellus, the others (more whitish) just within the bases of the antennae. Palpi and antennae pale brown, the latter darker on the stout basal segment. The antennal carinae and the crest of the frontal tubercle finely margined with black.

Prothorax with a broad yellow median band distinctly widened at both ends, traversed by a median brown impressed line that joins similar cross lines at its ends to make a toppled H-shaped figure. Sculpturings of the disc

heavy coarse brown, crowded next the yellow middle band, openly spaced towards the sides. There is an obscure pale double spot at the extreme front of the mesonotum and the remainder of the thorax above is blackish. Legs translucent brownish without pattern. Wings fulvous tinted with brown veins. Abdomen rather uniform brown in the male, paler and showing diffuse paired spots at sides of terminal segments in the female. Tails yellowish brown, clad within with short soft pubescence, and furnished at the tip of each segment with a long inferointernal bristle.

Male. Segments normal to the 9th save for a slight crescentric callosity (suggestion of a lobe) on the hind ventral apical border of the 8th. The 9th segment prolonged rearward beneath into a narrowed and upturned subgenital scoop, that nearly doubles the length of the segment and that is upturned at its tip to half the height of the segment. Segment 10 yellowish, enclosed in 9, and soft beneath, entire on its dorsal apical margin; two short blackish upturned subanal genital hooks rest close against its margin.

Female. Subgenital plate long covering fully half of the 9th sternite, semicircular in outline of its fore portion, well set off by lateral folds from the remainder of the 8th sternite. It bears two pairs of small and obscure brownish spots and there are larger spots at sides of segments 8 and 9.

Distribution.—Western North America:

British Columbia, Lake Lakelse, November, 1923.

Colorado, Tolland (G. S. Dodds); Florissant, June, 1907 (S. Rohwer).

Washington, Olympia, May 1, 1898; May 20, 1899; June 2, 1898.

Montana, Big Blackfoot River, Potomac, June 20, 1906.

Oregon, Corvallis, April 6 (J. C. Bridwell).

Alberta, Maligne Lake, July 1-3; Waterton Lakes, July 23, August 8 (J. McDunnough).

Clioperla marmorata, new species.

(Plate 13, fig. 6; plate 25, fig. 11.)

Length to wing tips, female, 18 mm.; expanse, 28 mm.

Color yellow, marbled with brown. Head yellow with a blackish band across the frons between the antennae, extended rearward in two blackish triangular lobes to cover the rear ocelli (thus making the yellow of the rear of the head trilobed anteriorly); a wash of paler brown

covers most of the clypeus before the yellow M-line across the frons. Ocelli minute, sub-equal and equidistant. Antennae brown, paler on base of flagellum; palpi darker brown.

Prothorax yellow, with a wide smooth middle tract and rather narrow borders all around set off by deep grooves. Embossed markings on the sides of the disc, brown, rather coarse, fewer toward the side margins. Two dots at the front of the mesothorax mark the angles of a wide yellow triangle, and the wing roots are yellow. Legs pale brown. Wings subhyaline with pale brown veins. All of the portion before the cord suffused with an amber-brown tint that deepens to strong brown over the anal area of the hind wing.

Abdomen brown. Tails yellowish, tapering, covered with short hairs; subanal lobes elongate triangular.

Female. Hind margin of the 8th sternite scarcely produced into a subgenital plate, broadly and evenly truncate.

Holotype female, Nevada, Cornell University Collection.

Clioperla sobria Hagen.

(Plate 25, fig. 9.)

1875. *Perla sobria* Hagen, Bull. Geol. Surv. Terr., p. 577.
1907. *Perla sobria* Banks, Cat. Neurop., p. 12.

Length to tip of wings, female, 15 mm.; expanse, 26 mm.

General color fuscous varied with yellow on head and prothorax.

Head a little wider than prothorax; with a yellow spot in the ocellar triangle, yellow beside the eyes, a yellow spot at the base of the antennae and one in front of the anterior ocellus; occiput mottled yellowish; rest of head dark brown to blackish; ocelli small, forming a triangle almost twice as wide as long, the hind ocelli closer to the eyes than to each other. Antennae dark brown.

Prothorax wider than long; sides nearly straight, not narrowed behind; light yellow with coarse chocolate brown rugosities; angles quite sharp. Legs brown. Wings subhyaline with brown veins; hind wings without intercubital crossveins.

Abdomen brown, tails pale yellow.

Male, unknown.

Female. Subgenital plate produced almost half way across the ninth sternite, rounded, with a narrow deep median notch.

Type, female, No. 247, Colorado Mts., Pacific Slope, August, 1873 (Hagen Collection, Mus. Comp. Zool., Cambridge).

Unknown to us. Redescribed from Hagen's type in the Museum of Comparative Zoology. The small "tubercle" of the subgenital plate, to which Hagen refers in his original description, was caused by shrivelling in drying.

Clioperla slossonae Banks.

1911. *Perla slossonae* Banks, Trans. Am. Ent. Soc., 37:335.

Length to tip of wings, female, 15.5 mm.; expanse, 26 mm.

General color black except for the yellowish stripe on prothorax and yellowish spots on the head. Head mostly black; sides of head yellow and front of clypeus yellowish; frontal ridge and lateral tubercles black, shining; hind ocelli closer to the eyes than to each other. Antennae dark brown to blackish.

Prothorax black with a wide median yellowish brown stripe; half again as wide as long; very slightly widened behind; angles rounded; surface only slightly rugose. Legs blackish with yellow tipped femora. Wings uniformly subhyaline; veins heavy brown.

Abdomen and tails black.

Male, unknown.

Female. The subgenital plate is very broad, occupying the entire width of the eighth sternite, produced over the ninth sternite and evenly rounded behind.

Female, type No. 11327, Franconia, N. H. (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.).

Genus ISOPERLA Banks.

1906. *Isoperla* Banks, Ent. News., 17:175.
1907. *Isoperla* Banks, Cat. Neurop., p. 13.
1909. *Isoperla* Enderlein, Zool. Anz., 34:390.

Mostly yellowish to greenish species, 6-15 mm. in length; hind wings without a series of cubital crossveins; males with a thickened knob on the posterior margin of the eighth abdominal sternite.

Head usually a little wider than prothorax, yellowish to dark brown usually with darker markings, either over the entire ocellar triangle or connecting the ocelli; ocelli three, the hind ocelli as close or closer to the eyes than to each other; lateral tubercles and frontal ridge not very prominent.

Prothorax rectangular, wider than long; mostly with a wide median yellow, longitudinal stripe and with brown rugose discs; rugosities sometimes on a yellow background, angles sharp or narrowly rounded. First tarsal segments about twice as long as second, third segment longer than one and two combined. Wings mostly green-

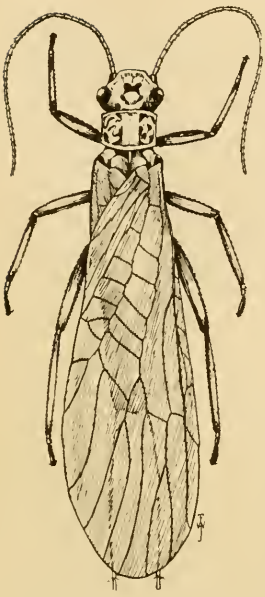

Fig. 19. *Isoperla bilineata* Say.

ish hyaline; subcosta usually does not reach the cord; a series of costal crossveins before the end of subcosta and from one to three crossveins beyond the end of subcosta; radial sector forked once beyond the cord; hind wing with a large folded anal area; no series of cubital crossveins in hind wing.

Abdomen with two long tails whose middle segments are three to five times as long as wide.

Male. Ninth abdominal sternite much produced so as to extend at least to the tip of the abdomen; eighth sternite with a rounded, thickened knob on the hind margin; subanal lobes modified into slender upturned or recurved hooks; tenth tergite entire; supra-anal process not developed.

Female. Eighth abdominal sternite either unmodified or with a well developed subgenital plate.

Genotype, *Sialis bilineata* Say.

Key to the Species of Isoperla.

1. Color blackish; female subgenital plate somewhat produced and broadly emarginate at tip; penis of male, when extruded, with two slender chitinized processes below ---------- *fusca*
   Color greenish, yellowish or brownish ---------- 2
2. Dark brown with very little yellow, prothorax almost twice as wide as long; less than 8 mm. in length ---------- *minuta*
   Mostly yellowish; if brown, with considerable yellow color on head and pronotum ---------- 3
3. Head with a round yellow spot in the ocellar triangle surrounded by dark brown; pronotum with a basal median yellow stripe and with brown sides ---------- 4
   Head either almost concolorous or with a V-shaped dark mark connecting the hind ocelli with the front ocellus; pronotum with a yellow median stripe and with the lateral margins yellow ---------- 6

4. Subanal lobes of male very long and slender, and genital plate emarginate at tip—*marlynia* sp. nov.
   Subanal lobes of male short and wider, female subgenital plate not emarginate ——— 5
5. Head usually with a round yellow spot in front of the anterior ocellus; knob on male eighth abdominal sternite about as wide as long; male 13-14 mm. long; female, 14-16 mm.——*signata*
   Head usually without a round yellow spot in front of the anterior ocellus; knob on male eighth abdominal sternite wider than long; male 10-11 mm. long ——— *ventralis*
6. Color pale yellow to brownish; female subgenital plate slightly produced and evenly rounded———— *bellona*
   Color yellowish with brown markings on head and pronotum ——— 7
7. Head mostly yellow, with no brown V-shaped mark connecting the ocelli ——— 8
   Head with a brown V-shaped mark connecting the ocelli ——— 10
8. Female subgenital plate produced over about half of the ninth sternite, with a slight emargination at the tip———5-*punctata*
   Female subgenital plate truncate, not produced— 9
9. Males 13-15 mm. in length, females 14-16 mm.; area behind the ocelli usually brownish; 2-3 costal crossveins beyond the end of subcosta———— *sordida*
   Males 10-11 mm. in length, females 11-12 mm.; area behind the ocelli usually yellow; one costal crossvein beyond the end of subcosta—*marmona*
10. Subgenital plate of female triangularly produced over most of the ninth sternite; subanal lobes of male bluntly pointed———*bilineata*
    Subgenital plate of female broadly rounded; subanal lobes of male sharply pointed ——— 11
11. Male 11-13 mm. long, female 13-15 mm.; female subgenital plate almost truncate———*montana*
    Male 10 mm. long, female 11-12 mm.; female subgenital plate evenly rounded behind—*longiscta*

Isoperla fusca, new species.

(Plate 26, figs. 4, 5, 6.)

Length to tip of wings, male, 9 mm.; female, 10-11 mm. Expanse, male, 16 mm.; female, 18-20 mm.

General color blackish with greenish-hyaline wings. Head wider than prothorax; dark brown to blackish, usually with yellow between the hind ocelli and just beside the eyes and sometimes also yellow on clypeus; lateral tubercles and frontal ridge moderately prominent; hind ocelli closer to eyes than to each other. Antennae blackish.

Prothorax dark brown with blackish rugosities; wider than long, not appreciably narrowed behind; sides straight; angles square; disc quite rugose. Legs blackish. Wings greenish-hyaline; subcosta does not reach to the cord; several costal crossveins before the end of subcosta and one beyond.

Abdomen blackish; tails yellowish at base, dark towards the tip.

Male. Ninth abdominal sternite much produced and rounded behind; eighth sternite with a yellow transverse knob on the hind margin; tenth tergite medially depressed; subanal lobes recurved, short, pointed; penis, when extended, membranous with a forked chitinous process as shown in Plate 26, figure 4.

Female. Subgenital plate of eighth abdominal sternite somewhat produced, broadly rounded and medially emarginate, sometimes with a wide shallow notch.

Distribution.—Holotype male, allotype female, July 12, 1923, Waterton Lakes, Alberta, Can. (J. McDunnough, Canadian National Collection). Paratypes, two males, three females from the same locality as the types.

When pinned this species appears almost wholly black with slightly greenish tinted wings, and when placed in alcohol the black color changes to a brown.

Isoperla minuta Banks.

(Plate 27, figs. 7, 8, 9.)

1900. *Chloroperla minuta* Banks, Trans. Am. Ent. Soc., 26:244.
1907. *Alloperla minuta* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 5.5-6 mm.; female, 6-7 mm. Expanse, male, 9-10 mm.; female, 10-11 mm.

General color brown to blackish, wings infuscated except costal margin which is yellow.

Head hardly wider than prothorax; brown to blackish, darker in the ocellar triangle; usually a small yellow spot between the hind ocelli; frontal ridge and lateral tubercles flat, shiny; hind ocelli at least twice as close to the eyes as to each other. Antennae yellowish at base, dark beyond.

Prothorax almost twice as wide as long; front and hind margins rounded; sides almost straight, angles somewhat

rounded; slightly narrowed behind; dark brown with a wide median yellow stripe which is somewhat widened posteriorly; sides of the disc quite rugose. Legs brown. Wings lightly to rather heavily infuscated, with a yellow costal margin; subcosta does not reach the cord; usually no costal crossveins between the humeral crossvein and the end of subcosta; one costal crossvein beyond the end of subcosta; no cubital crossveins in hind wing.

Abdomen brown; tails brown, a little lighter at base, the middle segments 4-5 times as long as wide.

Male. Ninth abdominal sternite much produced and rounded behind; eighth sternite with a transverse knob on the hind margin; subanal lobes slender, sharply pointed, recurved upon the tenth tergite; supra-anal lobe not developed.

Female. Subgenital plate of eighth abdominal sternite broad, produced over about half of the ninth sternite and evenly rounded behind.

Type, male, 11342, Columbus, Ohio, May 9, 1899 (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.). A male and female (paratypes) from the same locality, also in Banks Collection. Ohio, Columbus, April 10, 1920 (A. E. Miller); Illinois, Urbana, May 15, 1898 (F. M. McE.).

Isoperla marlynia, new species.

(Plate 25, figs. 12, 13, 14.)

Length to tip of wings, male, 12 mm.; female, 12-13 mm. Expanse, male, 21 mm.; female, 21-23 mm.

General color dark brown to blackish with a median yellow prothoracic stripe.

Head a little wider than prothorax; brown, with a yellowish spot in the ocellar triangle and with yellowish in front of the anterior ocellus; ocelli connected by a blackish V-shaped mark; occiput with three yellow spots: a V-shaped one in the middle and one beside each compound eye; frontal ridge and lateral tubercles not very prominent; hind ocelli closer to the eyes than to each other. Antennae blackish.

Prothorax dark brown, with a broad median yellow stripe; much wider than long; front angles angulate; hind angles rather sharp; sides of the disc with scattered rugosities.

Legs dark brown; wings subhyaline, with a very slight greenish tinge; veins brown; subcosta ends before the cord; a series of 5-6 costal crossveins before the end of subcosta and one beyond; hind wing without cubital cross-

veins. Abdomen dark brown; tails brown, the individual segments darker at the tip.

Male. Ninth abdominal sternite much produced and somewhat truncate behind; eighth sternite with a knob which is about as wide as long and is closely beset with very short prickles; subanal lobes modified into very long slender hooks which recurve upon the tenth tergite; supra-anal process not developed.

Female. Subgenital plate of eighth abdominal sternite produced over about a third of the following segment and with a broad, shallow median emargination.

Holotype, male, allotype, female, April 26, Lakehurst, New Jersey (Cornell University Collection).

Paratypes, three females, same locality as types.

Isoperla signata Banks.

(Plate 27, figs. 4, 5, 6.)

1902. *Perlinella signata* Banks, Can. Ent., 34:124.
1907. *Isoperla signata* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 13-14 mm.; female, 14-16 mm. Expanse, male, 23-25 mm.; female, 25-28 mm.

General color dark brown with yellow spots on head, a yellow median prothoracic stripe and greenish infuscated wings.

Head a little wider than prothorax; dark brown with a yellow spot in the ocellar triangle, a yellow spot in front of the anterior ocellus, yellow at base of antennae and with the occiput yellow (there is considerable variation in the color pattern on the head, but the yellow ocellar spot is usually present); hind ocelli much closer to the eyes than to each other; antennae brown.

Prothorax much wider than long; sides straight; sometimes slightly narrower behind; angles slightly rounded; a wide median yellow band which is widened behind; disc brown, somewhat rugose; sometimes a little yellow on the lateral margins. Legs brown, tarsi darker. Wings lightly greenish fumose; veins heavy brown; subcosta ends before the cord; a series of costal crossveins before the end of subcosta and one (rarely two) beyond; usually no cubital crossveins in hind wing.

Abdomen and tails brown.

Male. Hind margin of ninth abdominal sternite much produced and rounded behind; hind margin of eighth sternite with a rounded knob which is about as wide as long; subanal lobes recurved upon the tenth tergite and bluntly pointed.

Female. Subgenital plate normally produced over nearly half of the following sternite, evenly rounded behind.

Type female, No. 11340, Agr. Coll. Mich. (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.).

Distribution.—

New York, Ithaca, May 21-June 25; Ringwood near Ithaca, May 27, 1919 (H. Dietrich); Greene Co., June; Clinton, May 24 (P. B. Powell); Buffalo, July 10; Elizabethtown, July 2, 1923 (P. W. Claassen).

Nova Scotia, Truro, July 7, May 18, 1913 (R. Matheson).

Isoperla ventralis Banks.

(Plate 26, figs. 13, 14.)

1908. *Isoperla ventralis* Banks, Psyche, 15:66.

Length to tip of wings, male, 10-11 mm.; expanse, male, 17-19 mm.

General color dark brown with yellow on head and prothorax; wings greenish hyaline.

Head wider than prothorax; dark brown with a yellow spot in the ocellar triangle and yellow beside the eyes; ocelli connected by a wide V-shaped mark; lateral tubercles round, prominent; frontal ridge low, smooth; hind ocelli much closer to the eyes than to each other. Antennae brown, darker toward the tip.

Prothorax wider than long, hardly narrowed behind; front and hind margins rounded; sides straight; angles square; a wide median yellow stripe, somewhat constricted in the middle; disc quite rugose, the rugosities dark brown on a yellowish background. Legs brown, tarsi darker. Wings greenish hyaline; veins heavy brown; subcosta does not reach the cord; several costal crossveins before the end of subcosta and one beyond; no cubital crossvein in hind wing.

Abdomen brown, lighter at the tip. Tails yellowish at base, darker beyond.

Male. Ninth abdominal sternite much produced and rounded behind; eighth sternite with a transverse knob on the hind margin; subanal lobes sharp, recurved upon the tenth tergite; supra-anal process not developed.

Distribution.—Type male, No. 11333, July 28, 1906, Grand Lake, Newfoundland (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.); four other males, paratypes, from the same locality (Banks Coll.).

Isoperla bellona Banks.

(Plate 26, figs. 1, 2, 3.)

1911. *Isoperla bellona* Banks, Trans. Am. Ent. Soc., 37:336.

Length to tip of wings, male, 9-10 mm.; female, 11-12 mm. Expanse, male, 16-18 mm.; female, 19-22 mm.

General color pale yellow to brownish, the wings with a greenish yellow tinge.

Head wider than prothorax; yellow, usually with a dark spot in the ocellar triangle, sometimes with a dark V-sharped mark connecting the ocelli; clypeus a little darker; hind ocelli closer to the eyes than to each other. Antennae brown.

Prothorax much wider than long; a little narrowed behind; sides straight; angles narrowly rounded; yellowish with brown rugosities. Legs brown, tarsi darker. Wings with a greenish yellow tinge; subcosta ends before the cord; several costal crossveins before the end of subcosta and one or two beyond; no cubital crossveins in hind wing.

Abdomen and tails yellowish.

Male. Ninth abdominal sternite much produced and evenly rounded behind; eighth sternite with a rather narrow transverse knob; subanal lobes slender, sharp, recurved upon the tenth tergite; no supra-anal lobe present.

Female. Subgenital plate of eighth abdominal sternite somewhat produced and evenly rounded.

Type, female, No. 11334, Black Mts.. N. C., May (Banks Coll. Mus. Comp. Zool., Cambridge, Mass.).

Distribution.—

North Carolina, Black Mts., June, 1912 (Beutenmüller).

Georgia, Burton, May 21, 1911, 1,800 ft., Black Rock Mt., Rabun Co., May 20-25, 1911; Clayton, May 18-26, 1911 (J. C. Bradley); Tallulah Falls, June 19-25, 1909 (J. C. Bradley); Tallulah Falls, August 1909.

Isoperla 5-punctata Banks.

(Plate 26, figs. 7, 8, 11.)

1902. *Chloroperla 5-punctata* Banks, Can. Ent., 34:124.
1907. *Isoperla 5-punctata* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 9-12 mm.; female, 12-15 mm. Expanse, male, 15-19 mm.; female, 20-26 mm.

Length to tip of wings in short winged males, 6 mm.

General color yellowish brown with greenish wings. Head yellowish with dark marks around the ocelli and often with a black streak from the hind ocelli to the lat-

eral tubercle; lateral tubercles quite prominent, brownish; frontal ridge not very strong; hind ocelli closer to the eyes than to each other. Antennae brownish.

Prothorax narrower than head; wider than long; little or not at all narrowed behind; sides straight; angles rather sharp; brown rugosities on a yellowish background. Legs light brown; tarsi darker. Wings greenish hyaline; subcosta does not reach to the cord; three or four costal crossveins before the end of subcosta and about two beyond; at the origin of the radial sector often a portion of a crossvein extending toward media.

Abdomen yellow, tails yellow, darker towards the tip.

Male. Ninth abdominal sternite much produced and rounded behind; eighth sternite with a median knob which is about as wide as long; subanal lobes recurved upon the tenth tergite as slender sharp hooks; supra-anal lobe not developed.

Female. Subgenital plate of eighth abdominal sternite normally produced and rounded, with a slight median emargination.

Type female, No. 11337, Las Vegas, N. Mex., June 9, 1901 (T. D. A. Cockerell, Banks Coll. Mus. Comp. Zool., Cambridge, Mass.).

Distribution.—

New Mexico, Pecos, July-Aug., 1903 (T. D. A. Cockerell).

Colorado, Tolland (G. S. Dodds).

Newfoundland, Grand Lake, July 28 (Owen Bryant).

California, Claremont (Theresa Robinson).

Isoperla sordida Banks.

(Plate 27, figs. 13, 14, 15.)

1906. *Perla sordida* Banks, Can. Ent., 38:338.
1907. *Isoperla sordida* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 14 mm.; female, 14-16 mm. Expanse, male, 24 mm.; female, 24-29 mm.

General color yellowish brown with yellowish hyaline wings. Head wider than prothorax, brown with yellow in front and a little lighter color in the ocellar triangle; ocelli connected by an indistinct wide darker mark; lateral tubercles and frontal ridge not prominent; hind ocelli closer to the eyes than to each other. Antennae yellowish brown, darker toward the tip.

Prothorax wider than long; brown with a wide median yellow line and usually some yellow on the sides of the disc, which are very rugose; sides straight hardly nar-

rowed behind, angles almost sharp. Legs brown, tarsi somewhat darker. Wings with a yellowish greenish tinge; veins yellowish; subcosta ends before the cord; a series of costal crossveins before the end of subcosta and usually two or three beyond.

Abdomen yellowish brown; tails yellowish at base, darker beyond.

Male. Ninth abdominal sternite much produced and rounded behind; eighth sternite with a large transverse knob on the hind margin; subanal lobes pointed, recurved upon the tenth tergite; supra-anal process not developed.

Female. Subgenital plate truncate, little or not at all produced.

Distribution.—Type, female, No. 11338, Los Angeles Co., Calif. (Banks Collection, Mus. Comp Zool., Cambridge, Mass.).

CALIFORNIA, Claremont, May 28; Chico, Apr. 23, 1922 (E. P. Van Duzee).

WASHINGTON, Longmire, Spg., Mt. Rainier, July 26, 1919 (C. L. Fox).

Isoperla marmona Banks.

(Plate 27, figs. 1, 2, 3.)

1920. *Isoperla marmona* Banks, Bull. Mus. Comp. Zool., 64:322.

Length to tip of wings, male, 10 mm.; female, 11 mm. Expanse, male, 17 mm.; female, 19 mm.

General color yellowish brown with greenish hyaline wings.

Head wider than prothorax; yellowish brown; somewhat darker over the ocellar triangle and on clypeus and with a blackish spot between the ocelli; lateral tubercles and frontal ridge not very prominent; hind ocelli closer to the eyes than to each other. Antennae brown.

Prothorax wider than long; front and hind margins rounded, sides straight, not narrowed behind; angles almost square; a wide yellow median stripe and yellow on the lateral margins; rugosities rather coarse, chocolate brown upon a yellow background. Legs yellowish brown, tarsi darker. Wings greenish hyaline, veins brown; subcosta reaches almost to the cord; several costal crossveins before the end of subcosta and one beyond; Rs-M stem in hind wing longer than the cell which is formed by the branches of Rs-M before the cord; no cubital crossveins in hind wing.

Abdomen light brown; tails yellow.

Male. Ninth abdominal sternite much produced and rounded behind; eighth sternite with a knob on the hind

margin; subanal lobes sharp, recurved upon the tenth tergite; supra-anal process not developed.

Female. Subgenital plate of eighth abdominal sternite very little produced, truncate or slightly rounded, entire.

Distribution.—Type, female, No. 10822, June 22, Vinyard, Utah (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.).

Isoperla bilineata Say.

(Plate 14, fig. 2; plate 26, figs. 9, 10, 12, and text fig. 6.)

1823. *Sialis bilineata* Say, Godman's West. Quar. Rep., 2:165.
1833. *Perla bilineata* Newman, Ent. Mag., 5:499.
1842. *Perla bilineata* Pictet, Ins. Neurop., p. 283.
1859. *Perla bilineata* Le Conte, Ed. 1, p. 175.
1861. *Perla bilineata* Hagen, Ins. Neurop. N. A., p. 30.
1862. *Perla bilineata* Walsh, Proc. Acad. Nat. Sci. Phil., p. 366.
1883. *Perla bilineata* Provancher, Pet. Faun. Can. Neurop., p. 74.
1892. *Perla bilineata* Banks, Cat., p. 342.
1906. *Isoperla bilineata* Banks, Ent. News, 17:175.
1907. *Isoperla bilineata* Banks, Cat. Neurop., p. 13.
1907. *Isoperla bilineata* Tucker, Kans. Univ. Sci. Bull., 4:78.

Length to tip of wings, male, 10-12 mm.; female, 11-14 mm. Expanse, male, 18-22 mm.; female, 20-26 mm.

General color yellowish with greenish hyaline wings.

Head a little wider than prothorax; yellow with a brown spot over the ocellar triangle, sometimes the spot is triangularly emarginate behind so that the ocelli are connected by a broad V-shaped dark mark; a little darker on clypeus; lateral tubercles and frontal ridge not prominent; hind ocelli a little closer to the eyes than to each other. Antennae yellowish brown, darker toward the tip.

Prothorax wider than long; slightly, if at all, narrowed behind; sides straight; angles almost square; brown with a broad median yellow stripe; and sometimes with yellow on the outer lateral margin; surface not very rugose. Legs yellowish, tarsi darker. Wings greenish or yellowish hyaline, veins brown; subcosta does not reach to the cord; a series of costal crossveins before the end of subcosta and one beyond.

Abdomen and tails yellowish, the tails a little darker towards the tip.

Male. Ninth abdominal sternite much produced and evenly rounded behind; hind margin of eighth sternite with a median knob which is as long as wide; subanal lobes recurved, bluntly pointed; supra-anal process not developed.

Female. Subgenital plate triangularly produced and normally extending entirely across the ninth sternite.

Distribution.—Ohio River, near Cincinnati; Newfoundland to Saskatchewan and New Jersey to Colorado. The common eastern species.

Isoperla montana Banks.

(Plate 27, figs. 10, 11, 12.)

1898. *Chloroperla montana* Banks, Trans. Am. Ent. Soc., 25:199.
1907. *Isoperla montana* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 11.5-13 mm.; female, 13-14.5 mm. Expanse, male, 20-23 mm.; female, 23-26 mm.

General color yellow with brown on head and prothorax; wings greenish hyaline.

Head yellow with a wide brown V-shaped mark connecting the ocelli; frontal ridge and lateral tubercles inconspicuous, hind ocelli closer to the eyes than to each other. Antennae pale at base, darker beyond.

Prothorax a little narrower than head; wider than long, slightly narrowed behind; front and hind margins rounded; color yellow with brown rugosities on each side of the disc.

Legs yellowish, femora with a narrow transverse black band at the tip; tarsi dark. Wings greenish hyaline, veins yellowish brown; subcosta reaches almost to the cord; several costal crossveins before the end of subcosta and one beyond.

Abdomen yellowish brown; tails yellowish at base becoming darker towards the tip.

Male. Ninth abdominal sternite produced and evenly rounded behind; eighth sternite with a transverse knob on the hind margin; subanal lobes sharp, recurved upon the tenth tergite; supra-anal process not developed.

Female. Hind margin of eighth abdominal sternite produced into a broad, rounded subgenital plate which normally extends almost half way across the following sternite.

Distribution.—Type, male, No. 11339, Mt. Washington, N. H. (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.).

New York, Ithaca, June 13, 1906; May 26, 1919; May 27, 1922 (Ellis); Slaterville, June 13, 1904; Ogdensburg, July 16, 1906; Gloversville, June 13, 1901 (C. P. A.); Coy Glen, near Ithaca, June 4, 1910; Enfield, May 21, 1922 (P. M.); Newfield, June 5, 1923 (P. M.); Moore's Brook, near Ithaca, May 16, 1922 (C. K. Sibley); Taughannock, May 24, 1919 (H. Dietrich); Lakeside, Orleans Co., June 10.

Minnesota, St. Anthony Park, June 20.

Maine, Bar Harbor, June 8, 1921 (C. W. Johnson).

Isoperla longiseta Banks.

(Plate 26, figs. 15, 16, 17.)

1906. *Isoperla longiseta* Banks, Can. Ent., 58:337.
1907. *Isoperla longiseta* Banks, Cat. Neurop., p. 13.

Length to tip of wings, male, 10 mm.; female, 11-12 mm. Expanse, male, 17 mm.; female, 18-20 mm.

General color yellowish brown with greenish hyaline wings.

Head dull yellowish, the ocelli connected by a dark V-shaped mark; clypeus also a little darker; lateral tubercles indistinct; hind ocelli closer to the eyes than to each other. Antennae light at the base, darker towards the tip.

Prothorax narrower than head; wider than long; front and hind margins rounded, sides about straight, slightly narrowed behind; angles slightly rounded; brown rugosities on a yellow background, leaving a wide median yellow stripe and yellow margins. Legs yellowish brown, tarsi darker. Wings greenish hyaline; veins light brown, subcosta reaches almost to the cord; several costal crossveins before the end of subcosta and one beyond; hind wing without cubital crossveins.

Abdomen yellowish brown; tails about twice as long as abdomen; yellow at base, darker towards the tip; segments beyond middle about five times as long as wide.

Male. Ninth abdominal sternite much produced and evenly rounded behind; eighth sternite with a transverse knob on the hind margin; subanal lobes slender, sharp, recurved upon the tenth tergite; supra-anal lobe small.

Female. Subgenital plate of eighth abdominal sternite somewhat produced and evenly rounded behind.

Distribution.—Type, female, No. 11336, Onaga, Kans. (Banks Coll. M. C. Z., Cambridge, Mass.); Kansas, Onaga; Lawrence, June 26, 1919 (P. W. Claassen); Indiana.

Genus PERLESTA Banks.

1906. *Perlesta* Banks, Can. Ent., 38:222.
1907. *Perlesta* Banks, Cat. Neurop., p. 12.
1909. *Perlesta* Enderlein, Zool. Anz., 34:389.

Brown stoneflies, 9 to 14 mm. in length, with a yellow costal margin and with long slender tails.

Head a little wider than prothorax, usually with a blackish quadrangular spot over the ocellar triangle; three ocelli, the hind ocelli closer to the eyes than to each other.

Prothorax wider than long, somewhat narrowed behind; front angles subacute, hind angles rounded; brown to blackish; sometimes with a median yellowish stripe;

surface rugose. Legs brown, first two tarsal segments short, third segment at least twice as long as one and two combined. Wings subhyaline to dark fumose, with a yellow costal margin; costa, subcosta and costal crossveins lemon yellow, the other veins brown; subcosta reaches to or nearly to the cord; six or more costal crossveins before the tip of subcosta and several beyond; radial sector usually with three branches; anal field of hind wing large; Rs-M stem long; several cubital crossveins. Cerci long and slender, the middle segments four to five times as long as wide.

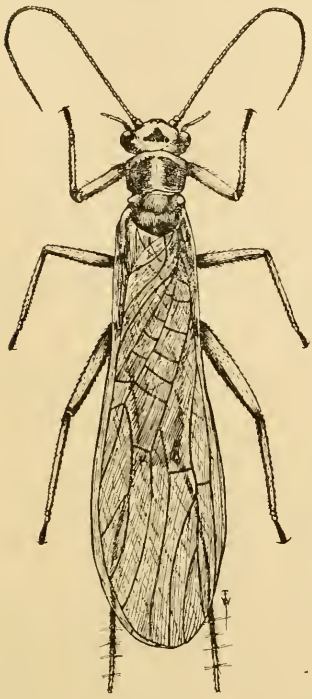

Fig. 20. *Perlesta placida* Hag

Male. Ninth abdominal sternite much produced and rounded behind; tenth tergite entire and posteriorly produced into a rounded lobe; subanal lobes modified into upturned, slender, finger-like processes.

Female. Subgenital plate somewhat produced, truncate and medially notched.

Genotype, *Perla placida* Hagen.

Distribution.—East of the Rocky Mountains.

There is a single species. There is considerable variation in the color of the wings and in the color pattern on the head. This has given rise to the description of eight species and varieties within this genus. Long series of specimens collected at the same time and place contain all the variable coloration and color patterns described under these species, but structurally they are all identical.

Perlesta placida Hagen.

(Plate 15, fig. 7; plate 24, figs. 15, 16.)

1861. *Perla placida* Hagen, Syn. Neurop. N. A., p. 28.
1892. *Perla placida* Banks, Cat. p. 342.
1904. *Perla placida* Banks, Proc. Ent. Soc. Wash., 6:205.
1906. *Perlesta placida* Banks, Can. Ent., 38:222.
1907. *Perlesta placida* Banks, Cat. Neurop., p. 12.
1907. *Perlesta placida* Tucker, Kans. Univ. Sci. Bull., 4:78.
1908. *Perlesta placida* Banks, Proc. Ent. Soc. Wash., 9:150.
1862. *Perla decipiens* Walsh, Proc. Acad. Nat. Sci. Phil., p. 364.
1892. *Perla decipiens* Banks, Cat., p. 341.
1907. *Perla decipiens* Banks, Cat. Neurop., p. 11.
1862. *Perla brunneipennis* Walsh, Proc. Acad. Nat. Sci. Phil., p. 367.
1892. *Perla brunneipennis* Banks, Cat. p. 342.
1907. *Isoperla brunneipennis* Banks, Cat. Neurop., p. 13.
1898. *Chloroperla virginica* Banks, Trans. Amer. Ent. Soc., 25:199.
1907. *Perlesta virginica* Banks, Cat. Neurop., p. 12.
1905. *Perlinella cinctipes* Banks, Psyche, 12:56.
1907. *Perlesta cinctipes* Banks, Cat. Neurop., p. 12.
1914. *Isoperla texana* Banks, Proc. Acad. Nat. Sci. Phil., p. 611.
1921. *Perlesta costalis* Klapalek, Annales, Soc. Ent. Belg., p. 5 of reprint.
1921. *Perlesta virginica* var. *immaculata* Klapalek, Ann. Soc. Ent. Belg., p. 5 of reprint.

Length to tip of wings, male, 9-11 mm.; female, 10-14 mm. Expanse, male, 16-20 mm.; female, 17-25 mm.

General color brown to blackish with yellow on head and with the costal margin of the wings yellow.

Head a little wider than prothorax; usually with a blackish quadrangular spot over the ocellar triangle, extending in front towards the base of the antennae; frontal ridge yellow; clypeus mostly dark brown; rest of head mostly yellow. There is a great deal of variation in the amount and shape of dark coloring on the head; in some specimens the ocelli are connected by a dark V-shaped mark; in others each ocellus is surrounded by a black ring while in still others the head is almost uniformly light brown. Hind ocelli closer to the eyes than to each other. Antennae yellowish at the base, except the first segment which is fuscous, blackish towards the tip.

Prothorax light to dark brown, sometimes with a yellowish, median longitudinal stripe; wider than long; narrowed behind; sides nearly straight; front angles subacute, hind angles somewhat rounded; surface rugulose. Legs brown; femora often darker on the outside; tarsi darker, first and second segments very short, third at least twice as long as one and two combined. Wings subhyaline to heavily infuscated with a yellow costal margin; veins brown except costa, subcosta and costal crossveins which are lemon yellow (the yellow costal margin is very pronounced in the darker specimens); subcosta

reaches to the cord or very nearly so; eight or more costal crossveins before the end of subcosta and several beyond; radial sector usually with three branches; hind wing with a large anal field and with several cubital crossveins.

Abdomen yellowish; cerci yellowish at base, infuscated towards the tip; the middle segment 4-5 times as long as wide.

Male. Ninth abdominal sternite produced and rounded behind; tenth tergite entire, produced backward into a broadly rounded lobe; subanal lobes modified into slender, finger-like, upturned processes which bear on the anterior side, near the tip, a small tooth.

Female. Hind margin of eighth abdominal sternite somewhat produced into a truncate subgenital plate which is notched in the middle and beset with long hairs.

Distribution.—Type, male, No. 253, Washington, in the Hagen Collection, Mus. Comp. Zool., Cambridge, Mass.

Vermont, Dummerston, July 14, 1908 (C. W. Johnson).

Massachusetts, Swansea, July 12, N. S. Easton; So. Framingham (C. A. Frost).

Connecticut, Middletown, June 17, 1909 (C. W. Johnson).

New Jersey, Jamesburg, July 2.

Maryland, Plummer's Island, May 18, 1915 (A. H. Pottinger).

Virginia, Dixie Landing, May 25.

West Virginia, Youghiogheny River, Cransville, July 22, 1914 (R. P. Currie).

Pennsylvania, Harrisburg, July 7, 1919; Allegh. Co., June 11, 1899 (E. B. Williamson); President, July 3-4, 1922 (J. B. Palmer); Westchester Co. (J. C. Bradley).

New York, Ithaca, May 15-August; Youngstown, July 20 (C. P. Alexander).

North Carolina, Raleigh, July 20, 1907; Southern Pines, Apr. 28 (A. H. Manee).

Georgia, Blackshear, May 10, 1911 (J. C. Bradley).

Texas.

Wisconsin, Milwaukee Co.

Indiana, Elkhart, June 18, 1902 (Weith).

Michigan, Ann Arbor, July 1-11.

Minnesota, Ramsey Co., Univ. Farm, Minneapolis, July 10, 1921 (W. E. Hoffman); St. Paul, June 25-29, 1921 (W. E. Hoffman).

Illinois, Fox River, June 25-27; Lake Forest, June 24-27 (J. G. Needham); Ill. River, Ottawa.
Iowa, Fairport, July, 1916.
Kansas, Baldwin, June (J. C. Bridwell); Riley Co., June 25 (Kimball); Miami Co., 1915 (R. H. Beamer); Lawrence, Douglas Co., June 21-August (P. W. Claassen).

Genus ATOPERLA Banks.

1905. *Atoperla* Banks, Psyche, 12:56.
1907. *Atoperla* Banks, Cat. Neurop., p. 12.

Brown, slender stoneflies, 9 to 16 mm. in length; with two ocelli about as far from each other as from the eyes; forewing with one to three crossveins between first and second anal veins.

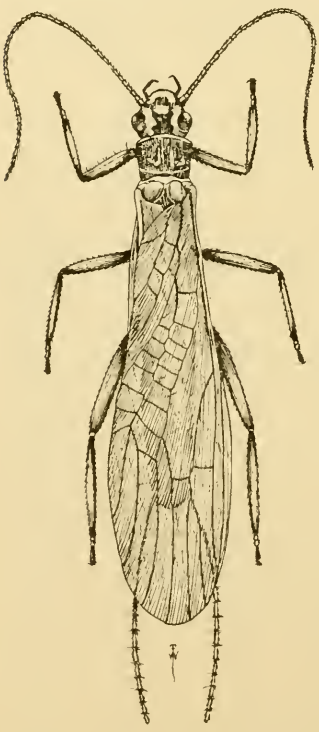

Fig. 21. *Atoperla ephyre* Newm.

Head a little wider than prothorax; usually with an infuscated or black squarish mark enclosing the ocelli; two ocelli, the anterior ocellus absent or sometimes indicated by a small dot or depression. Antennae brown, lighter at base.

Prothorax wider than long, somewhat narrowed behind; brown; slightly rugose; legs brown, first and second tarsal segments very short, subequal, third tarsal segment about twice as long as one and two combined. Wings subhyaline to fumose; usually no costal crossveins before end of subcosta; and one to four costal crossveins beyond the end of subcosta; radial sector with two branches beyond the cord; one to three crossveins between first and second anal veins of forewing; hind wing with a large anal field and with two to four cubital crossveins.

Cerci lighter at base, dark towards the tip, the middle segments four to five times as long as wide.

Male. Ninth abdominal sternite produced and bearing at the tip a yellow, transversely rounded knob; tenth abdominal tergite entire and normally retracted within segment nine; subanal lobes modified into slender, finger-like processes which recurve upon the tenth tergite; supraanal lobe not modified.

Female. Hind margin of eighth abdominal sternite somewhat produced and deeply and squarely notched in the middle.

Genotype, *Perla ephyre* Newman.

Distribution.—East of the Mississippi River.

Atoperla ephyre Newman.

(Plate 15, fig. 3; plate 24, figs. 10-14.)

1832. *Perla ephyre* Newman, Mag. Nat. Hist., 3:87.
1842. *Perla ephyre* Pictet, Ins. Neurop., p. 283.
1852. *Perla ephyre* Walker, Cat., p. 168.
1861. *Perla ephyre* Hagen, Syn. Neurop. N. A., p. 28.
1892. *Perla ephyre* Banks, Cat., p. 341.
1894. *Perla ephyre* Banks, Ent. News, 5:178
1907. *Perla ephyre* Banks, Cat. Neurop., p. 11.
1907. *Perla ephyre* Tucker, Kan. Univ. Sci. Bull., 4:78.
1862. *Perla producta* Walsh, Proc. Acad. Nat. Sci. Phil., p. 365.
1892. *Perla producta* Banks, Cat., p. 342.
1907. *Perla producta* Banks, Cat. Neurop., p. 12.
1862. *Perla fumipennis* Walsh, Proc. Acad. Nat. Sci. Phil., p. 366.
1892. *Perla fumipennis* Banks, Cat., 342.
1907. *Neoperla fumipennis* Banks, Cat. Neurop., p. 12.

Length to tip of wings, male, 9-12 mm.; female, 13-16 mm. Expanse, male, 16-20 mm.; female, 22-28 mm.

General color dark brown with subhyaline to fumose wings.

Head a little wider than prothorax; with a blackish or fuscous, quadrangular spot enclosing the ocelli and in front extending outward to the brown lateral tubercles; frontal ridge quite distinct; two ocelli which are a little closer to the eyes than to each other. (In some specimens there is a faint impression in the spot where the anterior ocellus occurs when present.) Antennae brown, except segments two and eight which are yellowish.

Prothorax slightly narrower than head; wider than long; a little narrowed behind; brown to blackish, sometimes variegated with yellow and brown; front angles narrowly, hind angles more broadly rounded; surface somewhat rugose. Legs brown; femora somewhat darker above; tarsi darker, first and second tarsal segments short, subequal, third tarsal segment at least twice as

long as one and two combined. Wings subhyaline to dark fumose; base of costa, subcosta and radius usually yellow; no costal crossveins before the end of subcosta (rarely one or two faint crossveins) and one to four costal crossveins beyond the end of subcosta; subcosta ends just before the cord; radial sector with two branches; forewing with one to three crossveins between first and second anal veins; hind wing with a large anal field; two to four cubital crossveins.

Abdomen brown, lighter underneath, in the male the ninth sternite is yellowish. Cerci with the first 6-8 segments usually yellowish, beyond the segments are tipped with brown, becoming entirely brown at the tip; middle segments 4-5 times as long as wide.

Male. Ninth abdominal sternite much produced and bearing near the end a yellow, transversely rounded knob, the area each side of the knob being deeply excavated; tenth abdominal segment entire, normally retracted within nine; subanal lobes modified into slender, sharply pointed, finger-like processes which recurve upon the tenth tergite; supra-anal process not developed.

Female. Hind margin of eighth abdominal sternite slightly produced into a bilobed subgenital plate, somewhat truncate behind and medially with a squarish notch; ninth sternite each side with a dark mark. (In some females the lobes of the subgenital plate, each side of the median notch, are more produced and square at the tip.)

Distribution.—June 9-July 19, Ithaca, N. Y.; July 31, 1922, Canandaigua Lake, Naples, N. Y. (M. D. Leonard); one male, June 16, Pa.; male and female, May 26, Hot Springs, Ark.; one male, N. C.; one female, April 17, 1903, Raleigh, N. C. (C. S. Brimley); one male, June 10, N. Reading, Mass. (C. W. Johnson).

Genus PERLINELLA Banks.

1900. *Perlinella* Banks, Trans. Amer. Ent. Soc., 26:242.
1907. *Perlinella* Banks, Cat. Neurop., p. 12.
1909. *Perlinella* Enderlein, Zool. Anz., 34:389.

Medium sized stoneflies 10-19 mm. in length; brown, with two broad yellow stripes on pronotum and with a row of crossveins in anal field of forewings.

Head a little wider than prothorax; yellow with two large black spots, one covering the ocellar triangle and extending outward toward the base of the antennae and the other over the clypeus in front of the yellow frontal ridge; three ocelli, the hind ocelli about as close to each other as to the eyes. Antennae blackish.

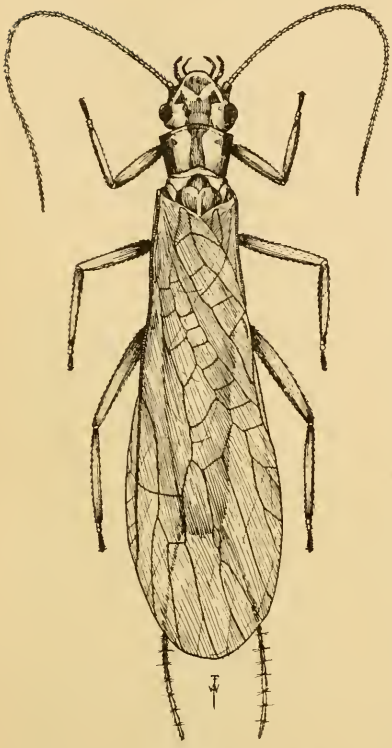

Fig. 22. *Perlinella drymo* Newm.

Prothorax wider than long, a little narrowed behind; all angles rounded; brown with a broad yellow longitudinal stripe on each disc, leaving a narrow brown median line and brown margins; surface somewhat rugose. First two tarsal segments very short, subequal; third tarsal segment at least twice as long as one and two combined. Wings subhyaline to fumose; few or no costal crossveins before end of subcosta and one to four beyond; two to four crossveins between first and second anal veins of forewing; hind wing with a large anal field and a series of cubital crossveins.

Abdomen brown, with two long slender cerci, whose middle segments are at least four to five times as long as wide.

Male. Ninth abdominal sternite produced and rounded behind and bearing before the apex a raised, yellow, transverse knob or hammer; tenth tergite entire; subanal lobes modified into slender, fingerlike, recurved hooks; supra-anal process not developed.

Female. Hind margin of eighth abdominal sternite slightly produced and medially broadly and deeply notched.

Genotype, *Isogenus drymo* Newm.

Distribution.—East of the Mississippi River.

Perlinella drymo Newman.

(Plate 24, figs. 6, 7, 8, 9, and text fig. 7.)

1839. *Isogenus drymo* Newman, Mag. Nat. Hist., 3:86.
1852. *Isogenus drymo* Walker, Cat., p. 146.
1861. *Perla drymo* Hagen, Syn. Neurop. N. A., p. 19.
1863. *Perla drymo* Hagen, Stet. Ent. Zeit., p. 371.
1892. *Perla drymo* Banks, Cat., p. 341.
1907. *Isogenus drymo* Banks, Cat. Neurop., p. 11.
1862. *Perla elongata* Walsh, Proc. Acad. Nat. Sci. Phil., p. 366.
1892. *Perla elongata* Banks, Cat., p. 341.
1907. *Perlinella elongata* Banks, Cat. Neurop., p. 12.
1895. *Perla trivittata* Banks, Trans. Am. Ent. Soc., 22:313.
1907. *Perlinella trivittata* Banks, Cat. Neurop., p. 12.
1909. *Perlinella trivittata* Enderlein, Zool. Anz., 34:389.

Length to tip of wings, male, 10.5-16 mm.; female, 16-19 mm. Expanse, male, 19-28 mm.; female, 28-34 mm.

General color brown; head yellow with two blackish spots; pronotum with two wide longitudinal yellow stripes.

Head a little wider than prothorax; yellowish with a large black mark over the ocellar triangle, bounded in front by the yellow frontal ridge and extending outward toward the base of the antennae; another black mark on the clypeus in front of the frontal ridge; a small dark area just behind the eyes; hind ocelli a little closer to the eyes than to each other. Antennae blackish.

Prothorax much wider than long, slightly narrowed behind; with a narrow, median, longitudinal dark line and each side of this with a wide yellow longitudinal stripe, narrowed before the front margin; lateral margins dark brown; all angles rounded. Legs dark brown to blackish; coxae and trochanters luteous; first and second tarsal segments very short, subequal, third tarsal segment more than twice as long as one and two combined. Wings subhyaline to fumose; subcosta reaches to the cord or very nearly so, usually without any costal crossveins before the end of subcosta and from one to four costal crossveins beyond the end of subcosta; three to four crossveins between first and second anal veins of forewing; hind wing with a large anal area and with a series of cubital crossveins.

Abdomen brown to blackish, usually lighter underneath. Cerci black, long and slender.

Male. Ninth abdominal sternite produced, evenly rounded behind and before the apex with a raised yellow transverse knob or hammer; the area each side of the knob excavated; tenth tergite entire with the median area somewhat depressed behind; subanal lobes modified into slender, pointed, fingerlike processes which recurve

upon the tenth tergite; supra-anal process not developed. In cleared specimens there appear a pair of chitinized, flattened, elongate, curved processes within segment nine; these processes bear a series of teeth on the outer edges as shown in Pl. 24, fig. 7. These processes, lying in the side walls of the penis, evidently function in copulation.

Female. Hind margin of eighth abdominal sternite a little produced, with a broad median notch; ninth sternite each side with a rounded dark mark.

Distribution.—May 23, 1900, Deer River, N. Y.; June 17, Sport Island, Sacandaga R., N. Y. (C. P. Alexander); May 18-July 7, Ithaca, N. Y.; July 15, Capens, Me. (C. W. Johnson); June 16, Jord Pond, Mt. Desert, Me. (C. W. Johnson); July 24, 1907, Alton, N. H. (J. A. Cushman); Canobie Lake, N. H. (Geo. Dimmock); July, Princeton, Mass. (L. W. Swett); Apr. 29, Manchester, N. J.; Elkhart, Ind.; June 28, Knoxville, Tenn.; North Carolina.

Genus PELTOPERLA Needham.

1905. *Peltoperla* Needham, Proc. Biol. Soc. Wash., 18:107.
1907. *Peltoperla* Banks, Cat. Neurop., p. 12.
1916. *Peltoperla* Needham and Smith, Can. Ent., 48:80.

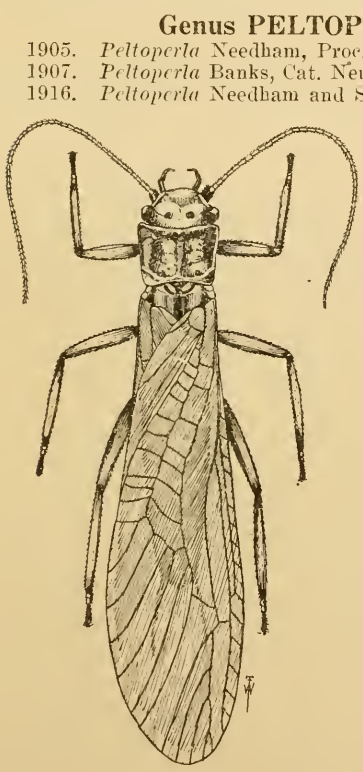

Fig. 23. *Peltoperla cora* Ndm. & Sm.

This genus includes species varying from 9 mm. to 30 mm. in length. It is characterized by the possession of but two ocelli; by a short head retracted under the front of a wide prothorax; long antennae; and very short caudal cerci that are often hardly longer than the abdomen is wide.

General color brown to blackish.

Head narrower than prothorax, yellowish to brownish, usually with a diffused spot over the middle area; ocelli usually closer to eyes than to each other; segments of palpi increase in length to the tip; antennae long, darker towards the tip.

Prothorax much wider than long, mostly with broadly flaring margins; not widened posteriorly; front angles

sharp or narrowly rounded; hind angles mostly broadly rounded; surface with large, irregular, flattened rugosities. Legs yellowish to brownish; first two tarsal segments very short, subequal, third segment very long, much longer than one and two combined. Wings subhyaline to blackish infuscated; numerous costal crossveins; subcosta terminates before the cord; the branches of Cu1 in the forewing usually originate from the anterior side; hind wing with a large anal field; usually no cubital crossveins in hind wing, except the end ones.

Abdomen with two short cerci.

Male. Ninth abdominal sternite prolonged and evenly rounded behind, bearing at or near the front margin a thickened button-like knob; from the base of the knob two divergent lines to the posterior margin of the ninth sternite, and the area between these lines usually sunken; subanal lobes broadly triangular, upcurved; supra-anal process developed into an upturned lobe, variously modified.

Female. Hind margin of eighth abdominal sternite either unmodified or produced into a rounded or notched subgenital plate.

Genotype, *Peltoperla arcuata* Ndm.

Key to the Species of Peltoperla.

1. Western species; males with a transverse knob on the ninth abdominal sternite located some distance back of the anterior margin; females with a large, wide subgenital plate which covers most of the ninth sternite and medially is notched ---------- 2

   Eastern species; males with a rounded knob on the anterior margin of the ninth abdominal sternite, the knob as wide as long; female plate usually without a median notch, or when notched the plate is only slightly produced---- 4

2. Ocelli closer to each other than to the eyes; wings usually heavily infuscated; a large species, males, 18-21 mm. in length, females 23-26 mm.; male supra-anal process composed of a globose membranous lobe; female plate broadly emarginate ---------- *cora*

   Ocelli closer to eyes than to each other; wings not heavily infuscated; size 9-18 mm. in length 3

3. Small species, 9-13 mm. long; radial sector with two branches; male with a globose, membranous supra-anal lobe; female with a narrowly notched subgenital plate ..... *brevis*
   Larger species, 18 mm. long; radial sector with three branches; supra-anal process of male composed of a median, chitinized knob, with a membranous wing each side; female unknown ..... *thyra*
4. Supra-anal process of male with a median, slender, chitinized rod, partly surrounded by a membrane; female subgenital plate broad and evenly rounded and reaching almost entirely across the ninth sternite ..... *arcuata*
   Supra-anal process of male without a median chitinized rod, globose and membranous; female plate either not produced or somewhat produced and evenly rounded or emarginate in the middle 5
5. Subgenital plate of female not at all produced; males 16 mm. long, females 20 mm. long ..... *anna*
   Subgenital plate of female somewhat produced; males less than 16 mm. long; females 15-18 mm. long 6
6. Subgenital plate of female emarginate, color brown; male unknown ..... *maria*
   Subgenital plate of female evenly rounded, color usually dirty yellowish; male genitalia as in *anna* ..... *cornelia*

Peltoperla cornelia Needham and Smith.

(Plate 31, figs. 4, 5, 6.)

1916. *Peltoperla cornelia* Needham and Smith, Can. Ent., 48:84.
1916. *Peltoperla dorothea* Needham and Smith, Can. Ent., 48:84.
1916. *Peltoperla ada* Needham and Smith, Can. Ent., 48:86.

Length to tip of wings, male, 12-14 mm.; female, 14-18 mm. Expanse, male, 22-28 mm.; female, 24-30 mm.

General color yellowish to brown.

Head yellow, usually with a diffused spot over the median area in front of the ocelli; and usually black on the inside of the ocelli; ocelli closer to the eyes than to each other; antennae yellowish, somewhat darker towards the tip.

Prothorax wider than head, yellowish to brownish; nearly twice as wide as long; front margin slightly concave; hind margin broadly rounded; somewhat narrowed

behind; front angles almost sharp; hind angles broadly rounded; surface moderately rugose. Legs yellowish, with a dark basal knee-cap on the outside of the tibiae, tips of tarsi darker. Wings yellowish to smoky hyaline; veins brown; subcosta ends a considerable distance before the cord; 13-16 costal crossveins before the end of subcosta and 7-10 beyond; radial sector with three to four branches.

Abdomen yellowish. Cerci yellow; the basal segment about as long as the following four segments.

Male. Ninth abdominal sternite produced and rounded behind, at the median basal area with a rounded knob which is about as wide as long; from the base of the knob two divergent ridges, the area between these ridges usually sunken; tenth tergite partly cleft; supra-anal process consists of a bulbose membranous lobe whose sides are slightly chitinized; subanal lobes triangular, upturned and quite sharply pointed.

Female. The hind margin of the eighth abdominal sternite produced into a broad evenly rounded subgenital plate which usually reaches at least halfway across the following segment.

Distribution.—Type, female, May 4, 1906, Cornelia, Ga. (Cornell University Collection); one male, May 31, Ramapo, N. Y. (Wm. T. Davis); males and females, May-June, Black Mts., N. C. (Wm. Beutenmüller); one female, May 24, 1911, Black Rock Mountain, Ga. (J. C. Bradley).

Peltoperla anna Needham and Smith.

(Plate 31, fig. 8; plate 15, fig. 5.)

1916. *Peltoperla anna* Needham and Smith, Can. Ent., 48:83.

Length to tip of wings, male, 16 mm.; female, 20 mm. Expanse, male, 31 mm.; female, 37 mm.

General color yellowish.

Head yellow, black between the ocelli; narrower than prothorax; ocelli closer to eyes than to each other; antennae yellow, darker towards the tip.

Prothorax yellowish brown, the median portion of each side of the disc a little darker; about half again as wide as long; front margin nearly straight; hind margin broadly rounded; front angles narrowly, hind angles very broadly rounded; surface moderately rugose. Legs yellow, with a knee-cap of brownish on the base of the tibia externally and the tips of the tarsi brownish. Wings yellowish hyaline with brownish veins; subcosta ends much before the cord; 10-14 costal crossveins before the end of subcosta

and 7-10 beyond; radial sector with 3 or 4 branches. Abdomen yellowish, darker towards the tip. Cerci brown, basal segment about as long as the following three segments in the female and somewhat longer in the male.

Male. Ninth abdominal sternite produced and rounded behind, at the median basal portion with a rounded knob which is about as wide as long; from the base of the knob two divergent ridges, the area between them being somewhat sunken; tenth tergite partially cleft; supra-anal process consists of a broad rounded membranous lobe whose sides are slightly chitinized; subanal lobes triangular, upturned, pointed.

Female. Hind margin of eighth abdominal sternite not produced into a subgenital plate.

Distribution.—Type, male and female, May 21, 1911, Burton, Ga. (J. C. Bradley, in Cornell University Collection). This species is very similar to *P. cornelia* and may be only a variety of that species.

Peltoperla maria Needham and Smith.

(Plate 31, fig. 7.)

1916. *Peltoperla maria* Needham and Smith, Can. Ent., 48:82.

Length to tip of wings, female, 15 mm. Expanse, female, 27 mm.

General color brown.

Head yellowish with a diffused brownish blotch over the median area in front of the ocelli; ocelli small, about twice as close to the eyes as to each other; antennae brown, somewhat paler at the base.

Prothorax brown; the large irregular flat rugosities a little darker; front margin nearly straight, hind margin broadly rounded; front angles narrowly, hind angles broadly rounded; a little narrowed behind; twice as wide as long. Legs yellowish, a narrow transverse dark band at the tip of the femora. Wings yellowish hyaline, veins brown; subcosta terminates considerably before the cord; 13-14 costal crossveins before the end of the subcosta and 7-8 beyond; radial sector with three branches.

Abdomen yellow, dark at the tip. Cerci brown, the basal segment about as long as the following three.

Male, unknown.

Female. Hind margin of the eighth abdominal sternite slightly produced in a subgenital plate which is medially widely notched.

Distribution.—Type, female, May 20, 1913, Pelham, Mass., (Lucy W. Smith, Cornell University Collection).

This may prove to be synonym of *P. anna* Ndm. & Sm.

Peltoperla arcuata Needham.

(Plate 31, figs. 1, 2, 3.)

1905. *Peltoperla arcuata* Needham, Proc. Biol. Soc. Wash., 18:108.
1907. *Peltoperla arcuata* Banks, Cat. Neurop., p. 12.

Length to tip of wings, male, 14-15 mm.; female, 18 mm. Expanse, male, 27-28 mm.; female, 34 mm.

General color brown.

Head brown, a little more obscure over the ocellar area; much narrower than the prothorax; ocelli large, with a black mark on the inside; about twice as close to the eyes as to each other; antennae brown, darker towards the tip.

Prothorax brown, nearly twice as wide as long; surface with broad, flat irregular rugosities; front margin nearly straight; hind margin convex; sides nearly straight; usually somewhat narrowed behind; front angles narrowly rounded; hind angles angulate and more broadly rounded. Legs yellowish, darker at the joints; tarsi dark. Wings brownish hyaline; veins brown; subcosta ends much before the cord; 13-16 costal crossveins before the end of sub-costa and 6-8 beyond; radial sector with about four branches.

Abdomen yellowish, darker towards the tip; setae yellow, with about 14-15 segments, the basal segment being very long.

Male. Ninth abdominal sternite somewhat produced, evenly rounded behind and bearing at the base of the segment a rounded knob which is as long as it is wide; from the base of the knob originate two divergent ridges, the median portion of the ninth sternite being sunken; tenth tergite partially cleft, each side with a slightly raised, rounded knob; supra-anal lobe composed of a median, slender, chitinized, upturned process which at the base is partially surrounded by a membranous sheath; subanal lobes large upturned and rather sharply pointed.

Female. Hind margin of eighth abdominal sternite produced into a broad, evenly rounded, subgenital plate which covers most of the ninth sternite.

Distribution.—Type, female, June 1891, Ithaca, N. Y. (R. H. Pettit, in the Cornell University Collection); one male, Ithaca, N. Y.; one male, 3-4 July, 1923, President, Pa. (J. B. Palmer).

Peltoperla thyra Needham and Smith.

(Plate 15, fig. 2; plate 31, figs. 9, 10.)

1916. *Peltoperla thyra* Needham and Smith, Can. Ent., 48:87.

Length to tip of wings, male, 18 mm.; expanse, male, 30 mm.

General color yellowish brown. Head obscure, but little darker around the ocelli; ocelli large, half again as close to the eyes as to each other; antennae yellowish at base, darker towards the tip.

Prothorax nearly uniformly yellowish brown, somewhat rugose; not quite twice as wide as long; narrowed behind; front angles quite sharp, hind angles broadly but somewhat angulately rounded. Legs yellow, with tips of tibiae and tarsi darker. Wings yellowish hyaline; veins amber brown; subcosta reaches almost to the cord; 15-16 costal crossveins before the cord, not counting the humeral crossvein, and 4-5 beyond subcosta; radial sector with three branches.

Abdomen yellowish, with the apical segments much darker; tails yellowish, basally, darker towards the apex, composed of about 15 segments.

Male. Ninth abdominal sternite is divided by a U-shaped suture or depressed area, which separates off the upturned posterior lobe from the basal part of the segment, and just before the suture on the midventral line there is a transverse, chitinized, raised knob; this knob is not elevated upon a stalk, but merely caps the midventral portion of the hind margin of this basal half of the ninth sternite; ninth tergite broadly excavated on the hind margin, a V-shaped notch almost dividing it in two in the median line. The edges of the V are upturned and chitinized. Tenth tergite reduced to a very narrow, thinly chitinized ring; supra-anal process short, recurved, knobbed at the end and bearing two thinner, wing-like appendages at its sides; the median terminal knob bears at the margin a row of sharp teeth. Within the apex of the ninth segment there are visible a pair of chitinized appendages, the nature of which is unknown. They are contiguous at the base and widely divergent at the tips, gradually tapering to a sharp point.

Female, unknown.

Distribution.—Holotype male, Nevada, Cornell University Collection.

Peltoperla brevis Banks.

(Plate 15, fig. 1; plate 31, figs. 11, 12, 13.)

1907. *Peltoperla brevis* Banks, Can. Ent., 39:328.
1916. *Peltoperla brevis* Needham and Smith, Can. Ent., 48:80, 82, 85.

Length to tip of wings, male, 9.5-11 mm.; female, 10-13 mm. Expanse, male, 16-19 mm.; female, 17-23 mm.

General color brown to blackish.

Head brown to blackish over the middle area, with yel-

lowish lateral margins and often with the hind margin of the occiput yellowish; lateral tubercles small, shiny; ocelli a little closer to the eyes than to each other. Antennae yellowish at base, except the first segment which is brown, brown toward the tip.

Prothorax dark brown, with the front and hind margin usually a little lighter; nearly twice as wide as long; front margin usually straight, hind margin rounded; front angles quite sharp, hind angles narrowly rounded; somewhat widened behind; surface somewhat rugose. Legs yellowish brown. Wings somewhat infuscated; the veins heavy brown; 13-14 costal crossveins before the end of subcosta and 2 or 3 beyond; subcosta ends much before the cord; radial sector with two branches.

Abdomen brown, a little lighter underneath, especially towards the tip. Tails brown, short, with about 7 to 9 segments.

Male. Ninth abdominal sternite prolonged beyond the tip of the abdomen, evenly rounded behind, with a yellow transverse knob in the center; from the base of the knob two diagonal grooves extend toward the hind lateral margin; tenth abdominal segment almost wholly withdrawn within the ninth segment; subanal lobes broadly triangular and not noticeably recurved at the tip; supraanal lobe largely membranous and in the form of a globose bulb with faint chitinization at the base.

Female. Eighth abdominal sternite produced into a broad, medially notched subgenital plate which normally reaches almost entirely across the ninth sternite.

Distribution.—Type, female, No. 11381, Aug. 21, Glacier, B. C., and another specimen, July 3, 1901, Port Renfrew, B. C. (in Banks Collection, Mus. Comp Zool., Cambridge, Mass.); one male, six females, July 16, 1907, Permelia L., Mt. Jefferson, Ore. (J. C. Bridwell); one female, July 16, 1911, Mary's Peak, Ore.; one female, July 25, 1920, Paradise Val., Mt. Ranier, Wash. (E. C. Van Dyke); two males, one female, June 27, 1921, Yosemite Val., Cal. (E. C. Van Dyke); two males, 7-3-16, Eldorado Co., Calif. (A. C. Browne).

Peltoperla cora Needham and Smith.

(Plate 31, figs. 14, 15, 16.)

1916. *Peltoperla cora* Needham and Smith, Can. Ent., 48:86.

Length to tip of wings, male, 18-21 mm.; female, 23-26 mm. Expanse, male, 34-39 mm.; female, 42-49 mm.

General color brown to dark brown with the wings lightly to heavily infuscated.

Head much narrower than pronotum; yellowish to almost black (in some specimens yellow with a large median dark diffused area); ocelli small, much closer to each other than to the eyes; antennae brown to blackish, somewhat lighter at the base.

Prothorax brown to blackish with the margins sometimes yellowish; front margin concave, hind margin nearly straight, sides bulging out somewhat and a little narrowed behind; much wider than long; front angles somewhat rounded; hind angles almost sharp; margins strongly flaring; surface quite rugose. Legs brown, darker above. Wings moderately to heavily infuscated, sometimes quite blackish; veins dark brown to blackish; subcosta reaches almost to the cord; 13-17 costal crossveins before the end of subcosta and 4-9 beyond; radial sector usually with 4-5 branches.

Abdomen brownish, lighter underneath. Cerci brown at the base, darker toward the tip, short and abruptly tapering; basal segment a little shorter than the following three segments.

Male. Ninth abdominal sternite produced and evenly rounded behind, bearing some distance forward from the hind margin a narrow, transverse, rounded knob; from the sides of this knob two divergent ridges and the area between these ridges sunken; tenth tergite triangular with the tips upturned; supra-anal lobe consists of a membranous, globose lobe.

Female. Hind margin of eighth abdominal sternite produced into a broad subgenital plate which covers most or all of the following segment, with a wide and shallow apical emargination.

Distribution.—Type, female, 1878, Reno, Nev. (Morrison, in the Mus. Comp. Zool., Cambridge, Mass.); four females, ten males, June 8-29, Shasta Springs, Calif. (C. L. Fox and E. P. Van Duzee).

Genus ACRONEURIA Pictet.

1841. *Acroneuria* Pictet, Perlides, p. 144.
1909. *Acroneuria* Klapalek, Bull. Internat. Acad. Sci. Boheme, pp. 1-14.

Large stoneflies, 20-40 mm. in length (*A. pumila* Bks. is somewhat smaller). Head wider than pronotum, either concolorous or with a dark area over the ocellar triangle and over the clypeus; frontal ridge in the form of a broad

letter M; lateral tubercles more or less oval in outline; the three ocelli forming an almost equilateral triangle; hind ocelli larger than the anterior ocellus and closer to each other than to the eyes; antennae brown, lighter at base. Prothorax wider than long, the angles sharp or narrowly rounded; surface not strongly rugose; the rugosities in the form of longitudinally outcurved, more or less broken, lines, leaving a median longitudinal smooth field which is narrowest in the middle. Legs yellowish; femora usually with a broad, dark transverse band just before the distal end. Wings uniformly hyaline or subhyaline. Abdomen brown; cerci or tails about as long as abdomen, the basal segments (except the first) much wider than long and more or less distinctly separated, gradually tapering toward the tip and rather thickly covered with short hairs.

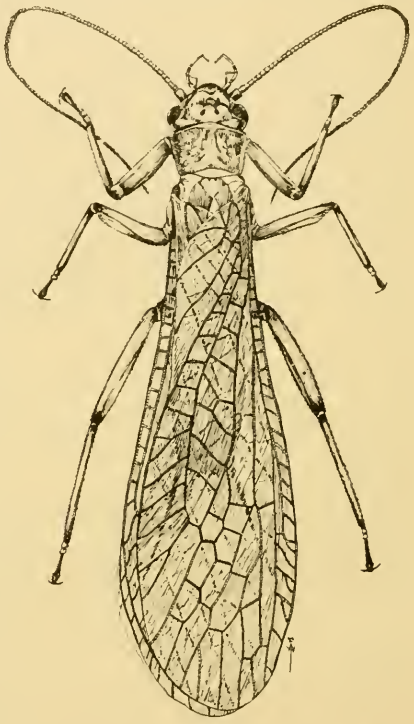

Fig. 24. *Acroneuria abnormis* Newm.

Male. Ninth abdominal sternite produced beneath so as to cover segment 10 completely, and bearing a rounded or squarish raised tubercle or hammer. The tenth abdominal segment almost completely withdrawn into segment 9. The subanal lobes are produced dorsally into short recurved hamules which recurve over the abdomen and reach onto the dorsal surface of the tenth tergite. The ninth, tenth and sometimes eighth tergites usually bear numerous short spines.

Female. The hind margin of the eighth sternite either unmodified or produced into a distinct subgenital plate.

Distribution.—This genus ranges over the entire area of the United States and Canada.

Acroneuria is closely allied to the genus Perla, from which the males may be separated by the presence of the hammer on the ninth sternite and the structure of the subanal lobes which have been modified into recurved genital hooks. There seems to be considerable variation in the structure of individuals within single species of this genus. Even the genital structures may show some variation. The eggs, however, have proved to be quite constant within the species and often serve to identify the females in doubtful cases.

The genus Acroneuria, as the name implies, was originally based on the presence of crossveins in the outer submarginal field of the wings, between the tips of the regular longitudinal veins and this character holds for most of the species within the genus; but there is considerable variation; some species have many crossveins while others have few or none. The number of crossveins varies also within the same species, and even between the right and left wings of the same individual.

Genotype, *Perla arenosa* Pictet.

Among the numerous species described by the older authors, *A. abnormis* appears to be the only one that has been correctly identified by all those who have discussed the genus. The others were found to be in a confusion that seemed at first to be inextricable. But a restudy of the types and topotypes in American collections, a comparison of notes made from types in European collections by helpfully minded colleagues, and adequate collections from typical localities, have enabled us to identify all the species of the older authors with some assurance.

Key to the Species of Acroneuria.

1. Fore wings suddenly widened beyond origin of Rs. Color wholly yellow. Female subgenital plate bilobed, the median notch rectangular. Male genital hooks cylindrical, bearing at the base a bunch of hairs; hammer small, longitudinally oval; segments 9 and 10 above with short spines ---------- *xanthenes*

   Forewings gradually widened to stigma. Color not wholly yellow ---------- 2

2. Second anal vein of hind wing many (about 12) branched, the branches variously anastomosing. Female subgenital plate produced over half

of segment 9, the hind margin evenly rounded. Male genital hooks cylindrical, sharp; hammer small, transversely oval; segments 8, 9 and 10 above with short spines _____*arenosa*

Second anal vein of hind wing 3-6 branched_____ 3

3. Crossveins numerous over the entire area in fore-wing beyond the cord; usually a pair of triangular dark spots on head behind the ocelli pointing inward. Female subgenital plate slightly produced, hind margin even. Male genital hooks flat, triangular, sharp; hammer transversely oval; segments 9 and 10 above with short spines _____*abnormis*

Area beyond the cord in fore wing not entirely filled in with crossveins; no triangular spots on head behind ocelli _____ 4

4. Head with a blackish spot covering the ocellar triangle; Eastern species _____ 5

Head usually pale or concolorous above including the ocellar triangle (*pacifica* sometimes with black over the ocellar triangle) _____ 8

5. With very few (1-4) crossveins in the area beyond the cord; female subgenital plate evenly rounded or somewhat excavated. Male genital hooks flattened, triangular, sharp; hammer small, transversely oval, segments 9 and 10 above with short spines _____ 6

With a larger number of crossveins in the area beyond the cord; female subgenital plate not evenly rounded; male genital hooks long cylindrical; segments 9 and 10 above with short spines, (male of *trijuncta* not known)_____ 7

6. Black spot over ocellar triangle rounded behind; female subgenital plate produced, hind margin either evenly rounded, truncate in the middle, or somewhat excavated _____*lycorias*

Black spot over ocellar triangle angulate behind; female subgenital plate produced, hind margin angulately emarginated in the middle_____ _____ *carolinensis*

7. Subgenital plate of female produced somewhat and bearing two flap-like lobes. These lobes are often found to be laid back over the plate so that the plate appears to be more or less evenly rounded _____*internata*

Subgenital plate of female produced over about half the length of segment 9, and bearing in the middle a short declivitous narrowed portion ---------- *trijuncta*

8. Head and thorax wholly blackish; no extra crossveins beyond the cord. Female subgenital plate not produced, hind margin entire. Male genital hooks short cylindrical; hammer large, longitudinally rectangular, surface ridged; no spines above on segments 9 and 10 ---------- *theodora*

Head and thorax pale or obscure, never wholly blackish ---------- 9

9. Usually with no crossveins beyond the cord; female subgenital plate not produced; western species ---------- 10

With crossveins beyond the cord; female subgenital plate produced and variously modified 11

10. Vein Sc weak and indefinite at its tip. Female subgenital plate cut straight across apex. Male genital hooks flat, triangular; hammer large, transversely oval; segments 9 and 10 above with short spines. Expanse of wings 50-70 mm. ---------- *depressa*

Vein Sc stronger and definite at its tips. Female subgenital plate not produced but somewhat emarginate in middle, 9th ventral segment of female with a rounded spot each side. Male genital hooks cylindrical; hammer longitudinally rectangular; no spines above on segments 9 and 10. Expanse of wings 40-55 mm. ---------- *californica*

11. Prothorax quadrangular ---------- 12

Prothorax strongly narrowed behind ---- *georgiana*

12. Median longitudinal depressed area between the rugosities of the pronotum wide (about 1/6 of width of pronotum). Male genital hooks flat, short and very broadly triangular, as wide as long; hammer transversely oval; female subgenital plate produced, and evenly rounded. Western species ---------- 13

Median longitudinal area of pronotum narrow (about 1/10 of width of pronotum); male genital hooks not as wide as long; female subgenital plate variously modified. Eastern species 14

13. Size large. Expanse of wings 30-50 mm. Female subgenital plate produced over half of segment 9, the hind margin slightly angulate and usually bearing at the apex a squarish shiny spot ---------- *pacifica*

    Size smaller. Expanse of wings 18-30 mm. Female subgenital plate produced over two-thirds of 9, the margin evenly rounded and not bearing at the apex a shiny spot ---------- *pumila*

14. Female subgenital plate much produced, either bilobed or bearing a declivitous projection. Male genital hooks cylindrical, segments 9 and 10 above with short spines ---------- 15

    Female subgenital plate not much produced, hind margin more or less evenly rounded. Male genital hooks flattened, triangular ---------- 16

15. Female subgenital plate narrow at base and at the apex two-lobed. Male genital hooks cylindrical, slender and usually outcurved, hammer small, somewhat circular ---------- *arida*

    Female subgenital plate with a declivitous projection whose hind margin is entire. Male genital hooks more broadly cylindrical and usually straight, hammer large, transversely oval ---------- *evoluta*

16. Female subgenital plate somewhat produced, evenly rounded and bearing before the apex a transverse narrow tubercle. Male genital hooks flat, broadly triangular, hammer transversely oval, segments 9 and 10 above without short spines ---------- *ruralis*

    Female subgenital plate somewhat produced, the hind margin slightly angulate, no tubercle before the apex. Male genital hooks flat, narrowly triangular, hammer transversely oval, segments 9 and 10 above with short spines ---------- *pennsylvanica*

Acroneuria abnormis Newm.

(Plate 16, fig. 1; plate 28, figs. 3, 4; plate 30, fig. 12.)

1838. *Perla abnormis* Newman, Ent. Mag. 5:177.
1842. *Acroneuria abnormis* Pictet, Ins. Neurop. (Perlides), 180.
1852. *Perla abnormis* Walker, Cat., 147.
1861. *Perla abnormis* Hagen, Syn. Neur. N. Am., 17.
1873. *Perla abnormis* Hagen, Geol. and Geog. Sur. Col., 574.
1892. *Acroneuria abnormis* Banks, Cat., 341.
1894. *Acroneuria abnormis* Banks, Ent. News, 5:178.

1907. *Acroneuria abnormis* Banks, Cat., 10.
1908. *Acroneuria abnormis* Banks, Proc. Ent. Soc. Wash., 11:150.
1909. *Acroneuria abnormis* Klapalek, Bul. Acad. Boheme, 14:5.
1922. *Acroneuria abnormis* Needham and Claassen, Can. Ent., 54:252.
1851. *Acroneuria sonans* Newport, Trans. Linn. Soc. London, 20:447.

Length of wings, male, 25-28 mm.; female, 32-42 mm. Expanse, male, 46-50 mm.; female, 54-70 mm.

General color light brown. Head wider than prothorax, yellowish with a dark spot over the front part of the ocellar triangle, and extending laterally toward the antennae; usually a pair of triangular dark spots on head behind the ocelli, pointing inward; clypeus brown; frontal M ridge wide, yellow; lateral tubercles flat, yellow. Antennae brown. Ocellar triangle nearly equilateral, the hind ocelli half again as close to each other as to the eyes.

Prothorax wider than long, narrower behind; front and hind margins rounded; sides nearly straight; front angles sharp, hind angles subacute; surface not very rugose; median line not very distinct. Legs yellowish, femora with a broad blackish transverse band just before the distal end; tibia with a dark band at base; tarsi dark. Wings uniformly subhyaline; veins brown; numerous crossveins beyond the cord distributed more or less evenly across the entire radial-median area.

Abdomen pale yellow above and underneath; sides somewhat darker. Cerci or tails brown, yellow at base; closely covered with short hairs.

Male. Ninth abdominal sternite with a transverse, oval, smooth hammer; subanal lobes broadly triangular, sharp and reaching to about the middle of the tenth tergite; tergites 9 and 10 each with a large number of short spines.

Female. Eighth abdominal sternite very slightly produced into an unevenly rounded subgenital plate. The subgenital plate varies in different individuals from an almost truncate plate which is not at all produced to an evenly rounded plate produced over a third of the ninth sternite.

Distribution.—

New York, Ithaca, June 5 to Aug. 27; Green Co., June; North Creek, July 4, 1918; Keene Valley, Essex Co., June 28, 1895; Oswegatchie.

North Carolina, Black Mts., July 1-Aug. 30, 1912, Beutenmüller.

Maryland, Glen Echo, May 29, 1899 (R. P. Currie).

CANADA, Quebec, Saguenay River, July 25, 1906 (George P. Engelhart); Ontario Co., Hastings (Evans).
WEST VIRGINIA, Chest River, June.
PENNSYLVANIA, Harrisburg, July 26; Jeannette, July 28; Landisburg, June 15.

Acroneuria arenosa Pictet.

(Plate 4, figs. 1-5; plate 16, fig. 2; plate 28, figs. 1, 2; plate 30, fig. 10.)
1841. *Perla arenosa* Pict., Hist Nat. Neur. Perlides, p. 178.
1907. *Acroneuria arenosa* Banks, Cat. Neurop., p. 11.
1922. *Acroneuria arenosa* Needham and Claassen, Can. Ent., 54:252.

Length to tip of wings, male, 25-27 mm.; female, 30-37 mm. Expanse, male, 42-45 mm.; female, 50-62 mm.

Color yellowish fuscous. Head wider than prothorax, yellowish; area in front of ocellar triangle brownish and often the ocellar triangle crossed by a brownish mark, which is rounded behind and laterally extends toward the base of the antennae; sometimes the entire head pale except for the darker antennal ridges and the area in front of the anterior ocellus. Frontal M-ridge and lateral tubercles fairly prominent, yellow. Ocellar triangle almost equilateral; hind ocelli closer to each other than to the eyes; a ring of black pigment inside the ocelli. Antennae with basal segment infuscated, beyond yellowish. Palpi yellowish brown.

Prothorax narrower than head, wider than long; somewhat narrowed behind; median line usually yellow; sides disc brownish, often with yellow spots; rugosities moderately distinct; angles quite sharp. Meso- and metathorax yellowish brown. Legs yellowish; femora with a wide dark band just before the distal end; tarsi darker toward the tip. Wings uniformly subhyaline; veins brownish; second anal vein of hind wing with about 12 branches, the branches variously anastomosing.

Abdomen yellowish. Tails yellowish, slightly darker toward the middle and beyond; thickly covered with rather short hair.

Male. The ninth ventral abdominal segment with a nearly rounded, or slightly transverse, distinctly raised polished hammer. The genital hooks slender, cylindrical, long, sharply pointed and reaching to or beyond the middle of segment 10. Segments 8, 9, and 10 above with short spines distributed as shown in pl. 28, fig. 1.

Female. The subgenital plate produced over about one-half of segment 9; the hind margin evenly rounded.

Distribution.—Type locality, Philadelphia, Pa.

NEW YORK, Ithaca, July 14, 1885; Ithaca, July 21; Long Island, 1902.

Massachusetts, Chicopee, July 7, 1899 (F. Knab).
Maine, Orono.
Pennsylvania, Harrisburg, July 19; Philadelphia; Allegheny Co.; Pittsburg; Marysville, July 9.
Maryland, Near High Island, June 27, 1899 (W. R. Maxon); Laurel, June 17, 1912 (E. B. Marshall).
District of Columbia, Washington, July 4, 1870 ("Insect Book, plate 26, fig. 4"); July 5 (W. V. Warner); June 25 and July 18; June 1, 1893 (F. C. Pratt).
Virginia, Great Falls, June 25 (H. L. Viereck).

Acroneuria ruralis Hagen.

(Plate 16, fig. 7; plate 29, figs. 1, 2; plate 30, fig. 13.)

1861. *Perla ruralis* Hagen, Syn. Neur. N. A., p. 18.
1920. *Acroneuria ruralis* Needham, Bull. U. S. Bur. Fish., 36:274.
1922. *Acroneuria ruralis* Needham and Claassen, Can. Ent., 54:253.
1862. *Acroneuria rupinsulensis* Walsh, Proc. Acad. Nat. Sci. Phila., p. 363.
1883. *Acroneuria quebecensis* Provancher, Pet. Faun. Can. Neurop., p. 72.
1905. *Acroneuria attenuata* Banks, Psyche, 12:55.

Length to wing tips, male, 29 mm.; female, 32 mm. Expanse, male, 32 mm.; female, 59 mm.

Color brown. Head yellowish brown with the frontal M-mark and clypeus before it darker, a faint transverse wash of brown beyond the rear ocelli. Ocelli large, forming an equilateral triangle, the rear ones a little nearer to each other than to the eyes. Antennae brown, darker toward the tip and on the upper side of the basal segment. Palpi yellowish brown.

Prothorax much wider than long, front and rear margins rounded, the front one even, the rear one a little emarginate in the middle, front angles sharp, hind angles less so. Rugosities upon the sides of the disc not numerous nor prominent. Legs dark brown. Femora with a blackish transverse band across the distal end. Wings uniformly subhyaline with brown veins.

Abdomen pale above and below, darker upon the sides. Tails yellowish at the base, becoming darker posteriorly and partially covered with short hairs.

Male. Ninth ventral segment with the usual polished hammer which is small and transversely oval. Genital hooks short, flat, triangular, and curved forward at their acute tips.

Female. Subgenital plate short and very broad, covering usually somewhat less than half of the 9th ster-

nite and with a transverse callosity in the middle before its tip.

Distribution.—Type locality, St. Louis, Mo.

Pennsylvania, Harrisburg, July 13, 15, 19; May 27, West Fairview, June 18.

Maryland, Plummer's Island, July 12 (H. S. Barber).

District of Columbia, Washington, June, 1893 (F. C. Pratt).

Manitoba, Aweme, June 6, 1903 (N. Criddle).

New York, Lewiston, July 13.

Kansas, Lawrence, July, 1894 (Hugo Kahl); Douglas Co. (E. S. Tucker); Lawrence, June, 1921 (P. W. Claassen).

Ohio, Cincinnati, July 12 (J. T. Lloyd).

Tennessee, Knoxville, June 24, 1891.

Colorado, Denver, August.

Illinois, Bloomington (C. C. Adams); Moline, August, 1897; Savanna, August.

Wisconsin, Dane Co., May 20.

Iowa, Fairport, June 8, 1921.

Acroneuria pennsylvanica Rambur.

(Plate 16, fig. 8; plate 29, figs. 3, 4; plate 30, fig. 8.)

1842. *Perla pennsylvanica* Rambur, Neurop., p. 456.

1909. *Acroneuria pennsylvanica* Klapalek, Bull. Internat. Acad. Sci., Boheme, p. 8.

1922. *Acroneuria pennsylvanica* Needham and Claassen, Can. Ent., 54:252.

Length to wing tips, male, 27 mm.; female, 31 mm. Expanse, male, 48 mm.; female, 55 mm.

Color yellowish brown. Head yellowish, in front a little darker. Frontal M-line weakly developed. Hind angles obscurely touched with brown. Ocelli large, the rear ones closer to each other than to the eyes, tubercles ringed with blackish. Antennae and palpi brown.

Prothorax a little narrowed to rearward, much wider than long, its angles sharp, front and rear margins rounded, especially the front one, sides straight, ground color yellow with brown rugosities that are not very high nor very numerous. A median longitudinal yellow line traverses the disc. Meso- and metathorax yellowish brown. Legs yellow. Femora with a wide blackish band just before the tip and tibiae with the basal fifth darker in color. Wings uniformly subhyaline with brown veins.

Abdomen yellow above and below, darker on the sides. Tails brown and hairy.

Male. Ninth ventral segment with a transverse oval, smooth hammer. Genital hooks somewhat flattened, recurved, rather bluntly pointed. Prickles on the dorsal side of segments 9 and 10 numerous, on the 9th continuous and on the 10th interrupted in the middle by an area of long appressed hairs.

Female. Subgenital plate oval, rounded and entire on the tip, overlapping the basal half of the 9th sternite and followed on that sternite by two small, round, brownish spots at the sides.

Distribution.—Type locality, Pennsylvania.

PENNSYLVANIA, Washington Co.; Jeannette, July 8, 1904 (H. G. Klages).

DISTRICT OF COLUMBIA, Washington.

NORTH CAROLINA, Morgantown, 1877 (Morrison).

TENNESSEE, Knoxville, May and June, 1889.

MARYLAND, Stubblefield Falls, Potomac River, June 3, 1902.

Acroneuria trijuncta Walker.

(Plate 28, fig. 24; plate 30, fig. 14.)

1852. *Perla trijuncta* Walker, Cat. Neur. Ins. Brit. Mus., p. 153.
1922. *Acroneuria trijuncta* Needham and Claassen, Can. Ent., 54:252.

Length to tip of wings, female, 30 mm. Expanse, 53 mm.

Color yellowish fuscous. Head wider than prothorax; a dark brown spot over the ocellar triangle, rounded behind and on each side produced toward the base of the antennae; frontal M-ridge very faint, yellowish; frontal tubercle moderately distinct; clypeus light brown; area beside the eyes and behind ocellar triangle yellow, somewhat infuscated on the hind margin. The ocelli form an equilateral triangle; hind ocelli somewhat closer to each other than to the eyes, inner margin with a black pigment ring. Antennae brown, lighter underneath; first palpi light brown.

Prothorax narrower than head; yellowish, somewhat darker around the border; wider than long, narrower behind, especially the posterior third; front margin evenly rounded; hind margin nearly straight; sides somewhat angulate; front angles subacute; hind angles narrowly rounded; surface moderately rugose. Meso- and metathorax yellowish, somewhat darker in the middle; underneath pale yellow. Legs yellow; femora above with a blackish broad mark just before the distal end; tibia brown at the basal end; tarsi darker toward the tip.

Wings subhyaline; veins brown, except veins C, Sc, R, and the costal crossveins which are yellowish. Venation as in figure.

Abdomen pale yellow above and below, sides brownish. Tails pale, somewhat darker towards the base; rather thickly covered with hairs.

Male, unknown.

Female. The ventral plate of segment 8 produced over about half of segment 9; a strong declivity in the middle, so that the apparent hind margin is evenly rounded and bears in the middle a somewhat triangular process, the margin of which is slightly excavated (pl. 28, fig. 24).

Distribution.—One female from Lake George, Juanita Island, N. Y., summer, 1920. The type locality is Georgia.

Acroneuria internata Walker.

(Plate 16, fig. 6; plate 28, figs. 5, 6; plate 30, fig. 5.)

1852. *Acroneuria internata* Walker, Cat. Neurop. Brit. Mus., p. 152.
1922. *Acroneuria internata* Needham and Claassen, Can. Ent., 54:252.

Length to tip of wings, male, 28 mm.; female, 30-35 mm. Expanse, male, 40 mm.; female, 52-60 mm.

Color yellowish brown. Head with a brownish spot covering the ocellar triangle, rounded behind and notched in front and sending a branch each way toward the eyes. A triangular brownish spot above the mouth and a brownish line before the base of each antenna. Elsewhere yellowish except for a touch of brown on the hind angles externally. Ocelli large, the posterior ones nearer to each other than to the eyes, and ringed internally with blackish pigment. Antennae yellowish beyond the brown basal joint, darker toward the tip; palpi yellowish.

Prothorax narrower than the head, somewhat narrowed rearward, a little wider than long with a narrow and obscure yellow middorsal line. Disc yellowish brown with moderately strong rugosities. Legs yellowish. Femora with a dark ring just before the tip. Wings uniformly subhyaline. Veins brown.

Abdomen yellowish brown, irregularly clouded with darker color. Tails brown, somewhat lighter on the basal segments, thickly covered with rather long hairs.

Male. The hammer on the prolonged 9th ventral sternite is transverse, oval, and smoothly polished. The genital hooks are long and slender and cylindrical, and sharply pointed.

Female. Subgenital plate covers the basal third or more of the 9th sternite, is oval in outline, and bears at

its apex two lobes that may stand out as shown in plate 28, fig. 5, or may be folded back so that the edge appears to be uniformly rounded.

Distribution.—Type locality, "North America."
West Virginia, Cheat River, June.
Illinois, Bloomington, June 21, 1894 (C. C. Adams).
Indiana, no locality.
Michigan, Ann Arbor, July, 1901.
Missouri, Columbia (C. R. Crosby).
Colorado, (Gillette).

Acroneuria arida Hagen.

(Plate 16, fig. 5; plate 28, figs. 7, 8; plate 30, fig. 9.)

1861. *Perla arida* Hagen, Syn. Neur. N. Amer., p. 18.
1905. *Acroneuria valida* Banks, Trans. Amer. Ent. Soc., 32:4.
1907. *Acroneuria arenosa* Banks, Cat. Neurop., p. 11.
1922. *Acroneuria arida* Needham and Claassen, Can. Ent., 54:253.

Length to tip of wings, male, 23 mm.; female, 28 mm. Expanse, male, 43 mm.; female, 53 mm.

Color yellowish. Head wider than prothorax, pale yellowish, fuscous in front of the frontal ridge and somewhat darker behind the eyes; frontal ridge and lateral tubercles weak, yellow; antennae dark. Ocelli forming an isosceles triangle, the hind ocelli closer to each other than to the eyes; a black ring inside of the ocelli. Antennae pale brown. Palpi brown.

Prothorax wider than long, somewhat narrowed behind; light chocolate brown; a narrow yellow median longitudinal line; sides of disc quite rugose, often with yellowish spots near the lateral margin; a depressed area near the lateral margin; front margin evenly rounded, hind margin somewhat angulate, sides straight; angles sharp. Meso- and metathorax brownish with paler marks in front. Legs yellowish, darker above; femora with a wide dark band just before the tip; tarsi dark. Wings subhyaline, veins brown, lighter in the hind wing. Venation as in pl. 16, fig. 5.

Abdomen yellowish, somewhat darker towards the tip. Tails light yellow, somewhat infuscated towards the tip, covered with moderately long hairs.

Male. Ninth ventral abdominal segment with a transverse oval, polished button. Genital hooks long, cylindrical, rather sharply pointed and reaching to or slightly beyond the middle of segment 10. Segments 9 and 10 above with a patch of spines on each side.

Female. Subgenital plate produced halfway across seg-

ment 9, narrower at the base and broadly emarginate in the middle, or bilobed.

Distribution.—The type locality is given as "New York or Philadelphia."

Arkansas, Marion Co., June 5, 1897 (McE.).
Ohio, Lakeside, July 20, 1901; Lake Erie, South Bass Island, July.
District of Columbia, Washington, June, 1895 (F. C. Pratt).
New York, Ithaca, June 25.
Illinois, Galena.
Indiana, Bluffton (C. C. Deam).
Tennessee, Knoxville, June 2, 5, and 24.
Texas, Kamper's Bluff, V. C., June 25, 1911.

Acroneuria evoluta Klapalek.

(Plate 28, figs. 9, 10; plate 30, fig. 11.)

1909. *Acroneuria evoluta* Klapalek, Bull. Internat. Acad. Sci. Bohem., p. 12.
1922. *Acroneuria evoluta* Needham and Claassen, Can. Ent., 54:253.

Length to tip of wings, male, 25-28 mm.; female, 35-37 mm. Expanse, male, 42-48 mm.; female, 60-64 mm.

Color yellowish brown. Head wider than prothorax, yellow, with a darker area in front of anterior ocellus, antennal ridges dark, a little darker over the ocellar triangle and usually a little darker behind the eyes; frontal M-ridge and lateral tubercles yellow, not prominent. The ocelli form an almost equilateral triangle; hind ocelli quite large and closer to each other than to the eyes, each with a narrow ring of black pigment. Basal joint of antennae brown, followed by yellowish and darker segments towards the apex. Palpi brownish.

Prothorax brownish, tending to be much darker than the head, sometimes uniformly brown or else the rugosities yellow; wider than long; narrowed behind, the angles rather sharp; rugosities not strong. Meso- and metathorax yellowish, the outer fields a little darker.

Legs yellowish; femora with a broad black band just before the distal end, tibia darker on the basal fifth; tarsi darker at tip. Wings uniformly subhyaline or slightly brownish; veins brown, in the hind wing somewhat lighter in color.

Abdomen yellow, the sides a little darker and sometimes darker toward the tip. Tails yellowish; in some specimens the segments are darker at the tip; covered with rather short hairs.

Male. Ninth ventral abdominal segment with a slightly oval, transverse, polished hammer; genital hooks cylindrical, sharp, usually curved outward toward the tip and reaching to or a little beyond the middle of segment 10; segments 9 and 10 above each side with a patch of short spines.

Female. Eighth ventral segment produced in the middle into a rather narrow subgenital plate which reaches half way across segment 9. At the base of the plate is a declivity. The plate is either evenly rounded behind, truncate, or slightly emarginate and sometimes there is a slight emargination on the sides of the plate at the base.

Type female in the Hofmuseum, Berlin.

Distribution.—Type locality, New Orleans.

KANSAS, Douglas Co., July; Baldwin; Riley Co. (J. B. Norton); Manhattan, July 1, 1921 (R. C. Smith); Lawrence, July, 1894 (Hugo Kahl); June 20-26, 1921 (P. W. Claassen).

OHIO, Catonbads, June 23.

MISSOURI, Columbia (C. V. Riley).

Acroneuria pacifica Banks.

(Plate 4, figs. 11, 12; plate 16, fig. 3; plate 29, figs. 7, 9, 10; plate 30, fig. 3.)

1900. *Acroneuria pacifica* Banks, Trans. Amer. Ent. Soc., 26:242.
1904. *Acroneuria nigrita* Banks, Trans. Amer. Ent. Soc., 30:98.
1922. *Acroneuria pacifica* Needham and Claassen, Can. Ent., 54:253.

Length to tip of wings, male, 32 mm.; female, 37 mm. Expanse, female, 58 mm.

Color dark brown except the head, the general color of which is yellowish. There is a blackish area over the entire ocellar triangle, delimited in front by the yellow that covers the M-line and that extends rearward along the inner margin of the eye and covers most of the rear of the head. Middle of clypeus and labrum brownish, frontal tubercles yellowish. Ocelli small, the middle one smaller than the others. Antennae and palpi brownish.

Prothorax a little narrower than the head, a little narrowed behind, especially in the posterior half, front angles rather acute, more so than the hind ones. Surface very rugose, chocolate brown in color, transverse grooves at front and rear deeply and broadly excavated. Rugosities are few and broad. Meso- and metathorax shining black. Legs brown; femora yellowish at the extreme tip. Wings uniformly tinted with brownish; veins a little darker.

Abdomen blackish brown above, the last two segments and the ventral surface lighter. Tails dark brown, hairy.

Distribution.—Type locality, Washington.

CANADA, Maligne Lake, Alberta, July 1-3, 1915 (E. L. Diven); Waterton Lakes, Alberta, July 21, 1923 (J. McDunnough).

COLORADO, Gunnison, July (Oslar); Tolland (G. S. Dodds).

OREGON, Elkton, March 26, April 5, 1896; Corvallis, June.

CALIFORNIA, Dunsmuir, Shasta Co.; Cisco, 1899; Yosemite Valley, June 12, 1921 (E. C. Van Dyke); Nevada Co., May 16, 1918 (E. R. Leach).

WYOMING, Yellowstone River, Aug. 5, 1921 (F. M. Sallee); Upper Falls, Yellowstone, Aug. 9, 1896 (R. P. Currie); Yellowstone River, July 21, 1921 (R. A. Muttkowski).

MONTANA, Bridger Mts., June 19, 1914, 5,000 ft.

WASHINGTON, Olympia, June 1, 1894.

Acroneuria pumila Banks.

(Plate 29, figs. 5, 6; plate 30, fig. 15.)

1906. *Acroneuria pumila* Banks, Can. Ent., 38:335.

1922. *Acroneuria pumila* Needham and Claassen, Can. Ent., 54:253.

Length to tip of wings, female, 17 mm. Expanse, female, 26 mm.

Color shining yellowish brown. Head uniformly yellowish except the posterior angles which are a little darker. Frontal tubercles are elongate, transverse ridges that extend well forward nearly opposite the middle ocellus. Ocelli ringed with black, antennae and palpi brown.

Prothorax wider than long, distinctly narrowed behind, remarkably rounded in front and somewhat rounded in the rear, especially on the angles. General color yellowish brown with darker margins, the surface rugose on each side, middorsal smooth space very wide, especially at its ends. Meso- and metathorax darker yellowish brown and uniform in color. Legs brown. Wings abbreviated, a little longer than the abdomen, subhyaline with the ends a little darker, especially in the vicinity of the anal cell. In the forewings many costal apical crossveins.

Abdomen brown, paler beneath. Tails brown, hairy, the hairs longer on the basal segments.

Distribution.—Type locality, Three Rivers, Cal.
Wyoming, Yellowstone River, Aug. 5, 1921 (F. M. Sallee).
Montana, no locality.
Canada, Maligne Lake, Alberta, July 1-3, 1915 (E. L. Diven).
California, Three Rivers.
Texas, no locality.

Acroneuria lycorias Newman.

(Plate 28, figs. 11, 12; plate 30, fig. 7, and text fig. 8.)

1839. *Perla lycorias* Newm. Am. Mag. Nat. Hist., 3:85.
1883. *Perla navalis* Prov. Pet. Faun. Can. Neurop., p. 73.
1908. *Acroneuria excavata* Banks, Trans. Am. Ent. Soc., 34:256.
1922. *Acroneuria lycorias* Needham and Claassen, Can. Ent., 54:252.

Length to tip of wings, male, 20-28 mm.; female, 30-35 mm. Expanse of wings, male, 32-46 mm.; female, 42-55 mm.

Color yellowish with darker markings. Head wider than prothorax, a dark brown spot covers the ocellar triangle. It is rounded in the rear and laterally extends to the base of the antennae. Tubercles yellowish brown, remainder of head yellow except beyond the eyes externally. Ocelli form an equilateral triangle, the rear ones are closer to each other than to the eyes and are rather conspicuously ringed with black pigment. Antennae brown, yellowish for a little way beyond the first segment. Palpi brown.

Prothorax narrower than the head, a fourth wider than long, yellowish with bosses that are usually brownish, a little darker about the borders. Meso- and metathorax yellowish brown, darker in the middle. Legs yellow. Femora with a dark transverse band across the distal end and a more or less triangular spot at the base above. Wings uniformly subhyaline. Veins brown. Veins beyond the cord few or wanting.

Abdomen yellow, a little infuscated on the side. Tails yellow at base, darker beyond, covered with short hair.

Male. The ventral prolongation of the 9th segment bears the usual polished disc or hammer, oval in form and smooth. Genital hooks are flattened, triangular, sharply pointed at their anteriorly directed tips. Segments 9 and 10 both are well covered with minute prickles.

Female. The subgenital plate is slightly produced to rearward, the hind margin varies between being evenly rounded or truncate or slightly excavated in the middle.

Distribution.—Type locality, Trenton Falls, N. Y.

New York, Ithaca, May 30, June 27, July 16; The Hermitage, Cayuga Lake, June 10 (C. Betten); McLean Bogs, Tompkins Co., June 11, 1915; Colden, June 7, 1908 (E. P. Van Duzee); Ft. Montgomery, May 21; Otto, June 1903; Ramapo, May 21; Gloversville, June 13 (C. P. Alexander); Artists Brook, Chapel Pond, Adirondack Mts., June 28, 1923 (P. W. Claassen); Castile, Wyoming Co., 1923.

Maine, Tim Pond Plantation, July 22, 1922; Capens, July 14 and 15, 1901 (C. W. Johnson); Orono; Great Pond, Mt. Desert, July 20, 1921 (C. W. Johnson).

New Hampshire, Squam Lake, July 25 (G. M. Allen).

Massachusetts, Fall River, June 19, 1909 (N. S. Easton).

West Virginia, Cheat Mts., June.

Wisconsin, Door Co., June 12, 1905; July 1 to 15, 1906.

Pennsylvania, Jeannette (H. G. Klages); Pittsburg.

Quebec, July 25, 1907 (George Maheux).

Michigan, Marquette, June 29, (Hubbard and Schwarz).

Kansas, Lawrence, Douglas Co.

Acroneuria carolinensis Banks.

(Plate 28, figs. 13, 14.)

1905. *Acroneuria carolinensis* Banks, Bull. Amer. Mus. Nat. Hist., 30:215.

1922. *Acroneuria carolinensis* Needham and Claassen, Can. Ent., 54: 253.

Length to tip of wings, male, 28 mm.; female, 34 mm. Expanse, male, 45 mm.; female, 58 mm.

Color dark brown varied with yellow. Head nearly covered with a blackish spot that follows in the rear the frontal suture and is angulate in the middle, that is often traversed by a pale M-line on the frons, and that is punctuated with yellow on the frontal tubercles. Rear of head and space around the eyes yellow. Antennae brown, yellowish for a distance beyond the basal segment. Palpi brown.

Prothorax a little wider than long, a little narrowed beyond, angles acute, front margin rounded, rugosities moderate, usually shining blackish, median sulcus also

blackish. Entire pronotum covered with fine gray pile. Meso- and metathorax blackish brown. Legs dark brown. Tarsi blackish. Wings subhyaline with dark brown veins.

Abdomen dark brown, somewhat lighter toward the tip and beneath. Tails brown.

Male. Segment 9 with the usual transversely oval polished hammer on the prolonged ventral extension. Genital hooks slender, curving upward and inward and ending in sharp incurved points. Prickles on the dorsal surface of segments 9 and 10 very numerous.

Female. Subgenital plate extends about half way across the 9th sternite, is broadly oval in outline, with the median emargination making its apex bilobed. Lobes rounded.

Distribution.—Type locality, Black Mountains, N. C.

North Carolina, Black Mts., July 1-Aug. 30, 1912 (Beutenmüller); Sunburst, Haywood Co., late May (C. S. Brimley).

Acroneuria depressa Needham and Claassen.

(Plate 16, fig. 4; plate 28, figs. 15, 16; plate 30, fig. 6.)

1922. *Acroneuria depressa* Needham and Claassen, Can. Ent., 54:253-254.

Length to tip of wings, ♂, 29-32 mm.; ♀, 32-40 mm. Expanse, ♂, 48-50 mm.; ♀, 56-70 mm.

General color light brown. Head wider than prothorax, reddish brown, darker on clypeus and somewhat darker over the ocellar triangle. Ocelli large, with black on the inside; hind ocelli a little closer to each other than to the eyes. Prothorax wider than long, not narrowed behind, angles rather sharp, rugosities not very strong. Legs yellowish; femora with a black transverse band just before the tip. Wings uniformly subhyaline; veins light brown; usually no crossveins in the outer field beyond the cord. Tails light brown thickly clothed with short hairs.

Male. Ninth ventral segment bears a large, transverse, oval, smooth hammer; subanal lobes flattened, triangular, sharply pointed; segments 9 and 10 above each with many short spines.

Female. Eighth ventral segment unmodified.

Distribution—

Washington, Yakima River, Lonetree, June 30, 1882.

California, Strawberry Valley, Eldorado Co., Aug. 5, Aug. 13 (E. C. Van Dyke); Woods Creek, Fresno Co., July 22 (E. C. Van Dyke); Terwak, Del Norte Co., Sept. 9, 1920 (Carl D. Duncan).

Acroneuria theodora Needham and Claassen.

(Plate 16, fig. 9; plate 28, figs. 21, 22, 23; plate 30, fig. 4.)

1922. *Acroneuria theodora* Needham and Claassen, Can. Ent., 54: 254.

Length to tip of wings, male, 15 mm.; female, 35-37 mm. Expanse, male, 20 mm.; female, 59-63 mm.

General color blackish with smoky wings. Head a little wider than prothorax; black over the ocellar triangle and extending laterally to the base of the antennae; occiput and area in front of the frontal M-ridge dark brown; frontal ridge and lateral tubercles yellowish; ocelli form an equilateral triangle; hind ocelli closer to each other than to the eyes. Antennae blackish at base, brown towards the tip. Prothorax uniformly blackish, wider than long, somewhat narrowed behind; front angles sharp, hind angles rounded; rugosities rather strong. Wings pale yellow at base, beyond uniformly smoky; veins blackish; no crossveins in the outer field beyond the cord. Basal half of abdomen yellowish above, beyond blackish. Tails brown, thickly clothed with short hairs.

Male brachypterous; ninth ventral segment bears a large, longitudinally rectangular hammer whose surface is covered with rearward curving ridges; subanal lobes cylindrical, short and sharp.

Female. Eighth ventral segment unmodified.

Distribution.—

Wyoming, Big Horn Mts., June 18, 1896 (R. P. Currie).

Montana, Gallatin Mts., Aug. 15, 1914, 6,000 ft., Yellowstone Park, Gallatin Mts., Aug. 14, 1921 (R. H. Muttkowski).

Acroneuria californica Banks.

(Plate 28, figs. 17-20; plate 30, fig. 1.)

1905. *Acroneuria californica* Banks, Invert. Pacifica, 1:87.
1905. *Acroneuria californica* Banks, Trans. Am. Ent. Soc., 32:3.
1908. *Acroneuria concolor* Banks, Trans. Am. Ent. Soc., 34:255.
1922. *Acroneuria californica* Needham and Claassen, Can. Ent., 54: 253.

Length to tip of wings, male, 23 mm.; female, 31 mm. Expanse, male, 40 mm.; female, 54 mm.

Color brown, varied with yellow.

Head pale, area over ocellar triangle pale reddish yellow; clypeus also lighter; a dark spot each side between the front ocellus and the lateral tubercles, rear of head darker; tubercles yellowish, distinct; frontal ridge rather weak; the ocelli form an almost equilateral triangle; hind

ocelli much closer to each other than to the eyes; inside of the ocelli a narrow dark ring of black pigment. Antennae with the first segment dark brown, lighter beyond; palpi dark brown.

Prothorax narrower than head, slightly widened behind; wider than long; sides straight; angles rather sharp; median line yellowish, obscure; disc brown, somewhat lighter laterally, strongly rugose. Meso- and metathorax brown with yellow at the front and at the base of the wings. Legs brown, femora with a dark band just before the distal end; tibiae darker at the base; tarsi fuscous. Wings uniformly subhyaline, veins brown; crossveins lacking in the outer submarginal area.

Abdomen light yellowish at base, darker beyond. Tails yellowish brown; basal segments very short; rather sparsely covered with hairs.

Male. Abdomen segment 9 abbreviated and thickened, concave, and scurfy pubescent on its slightly upturned apical margin, prolonged on the ventral side into a rather narrow and strongly upturned subgenital scoop, whose postero-ventral face bears an elongate, subrectangular hammer, whose surface is polished and whose proximal end is confluent with forward part of the segment by a widening area, that is set off at the sides by two deep folds. Genital hooks long, subcylindric, erect, tapering into sharp points that turn forward and inward at extreme apex.

Female. Subgenital plate wanting, the 8th sternite slightly concave on its apical border; two oval blackish spots are upon the sides of the 9th sternite.

Distribution.—Type locality, Claremont, Cal.

CALIFORNIA. Paradise Val., Kings River, Fresno Co., July 15, 1910, alt. 7,000 ft. (E. C. Van Dyke); Oakland, May 15, 1910 (E. C. Van Dyke); Bear Val., Marin Co., May 25, 1919; Lagunitas, Marin Co., June 14, 1908 (E. C. Van Dyke); Three Rivers, 600-800 ft., July 12-14, 1907; Saquel Creek, Santa Cruz Co., May 30, 1909 (E. C. Van Dyke); Sonoma Co., June 19, 1910 (J. E. Kuschel); Lander, July, 1899; Felton, Santa Cruz Mts., May 29 (J. C. Bradley); Redwood, Corralitos, Santa Cruz Mts., May 13, 1907 (J. C. Bradley); Fallen Leaf Lake, July 12; Fairfax, Marin Co., June 14 (E. C. Van Dyke); San Jose, Oct. 13, 1881 (Mrs. A. E. Bush); Dunsmuir (Wickam);

Santa Cruz Mts. (Mrs. A. E. Bush); Mariposa Grove, 6,150 ft., May 14, 1879; Fresno Flats, 3,500 ft., May 9.

WASHINGTON, Forks, Chatham Co., July 5, 1920 (E. C. Van Dyke).

OREGON, Corvallis, May 29.

Acroneuria xanthenes Newman.

(Plate 16, fig. 10; plate 29, figs. 8, 11, 12; plate 30, fig. 2.)

1828. *Perla xanthenes* Newman, Ent. Mag., 5:178.
1841. *Perla xanthenes* Pictet, Ins. Neur., p. 245.
1852. *Perla xanthenes* Walker, Cat., p. 159.
1861. *Perla xanthenes* Hagen, Syn. Neur. N. A., p. 26.
1892. *Perla xanthenes* Banks, Cat., p. 342.
1894. *Perla xanthenes* Banks, Ent. News, 5:178.
1904. *Perla xanthenes* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Perla xanthenes* Banks, Cat., p. 12.
1907. *Perla xanthenes* Tucker, Kan. Univ. Sci. Bull., 4:78.
1908. *Perla xanthenes* Banks, Proc. Ent. Soc. Wash., 9:150.
1908. *Perla xanthenes* Banks, Trans. Amer. Ent. Soc., 34:257.
1921. *Eccoptura xanthenes* Klapalek, Bull. de la Soc. Ent. de Belgique, 61:60.
1922. *Acroneuria xanthenes* Needham and Claassen, Can. Ent. 54:252.
1923. *Eccoptura xanthenes* Klapalek, Coll. Selys IV, 2:63 (female).*
1909. *Acroneuria brevidicauda* Klapalek, Bull. Internat. Acad. Sci. Boheme, p. 12.

Length to wing tip, ♂, 22-26 mm.; ♀, 29-32 mm. Expanse, ♂, 38-44 mm.; ♀, 46-54 mm.

General color pale yellow.

Head a little wider than prothorax; pale yellow; frontal ridge and lateral tubercles distinct; ocelli form an equilateral triangle; hind ocelli as close to the eyes as to each other; on inner margin of ocelli a black ring. Antennae pale, covered with short hairs; palpi pale.

Prothorax uniformly pale yellow, narrower than head, a little wider than long, narrower behind; angles subacute; front margin evenly rounded, sides and hind margin somewhat angulate; surface moderately rugose; each side with a rather deep depression near the margin, just back of the middle; legs uniformly pale yellow; wings pale yellow, nearly hyaline; veins yellow; C, Sc, R1, and the costal crossveins paler than the other veins.

Abdomen yellow; cerci or tails yellow, hairy; basal seg-

*Note: The male specimen (one of Newman's types) on whose secondary sexual characters Klapalek founded his genus Eccoptura, does not belong with the female (also figured by Klapalek as one of Newman's types): The species represented by the female has been consistently regarded as the *xanthenes* of Newman, has been frequently collected with its corresponding male, and less confusion will ensue if the female type be allowed to stand as the true type of this species. What the male is we do not know. We did not know of its existence when we published our note on *xanthenes* in the Canadian Entomologist for 1922, p. 252.

ment half again as long as broad; second and third segment each a little wider than long; fourth and fifth about as long as wide.

Male. The ninth abdominal sternite hairy, with a small, prominent, longitudinally oval, smooth hammer; subanal lobes modified into cylindrical recurved hooks, bluntly pointed, and with a brush of hairs on the hind basal margin. Tenth abdominal tergite with about twelve short spines on pegs each side of the middle, the other tergites smooth.

Female. The subgenital plate of the eighth abdominal sternite large, hairy, and produced over almost the entire ninth segment; deeply and squarely excised in the middle so as to leave a large lobe on each side.

Distribution.—One ♀, Raleigh, N. C., May 27 (C. S. Brimley); four ♂s, five ♀s, Black Mts., N. C., June 1-Aug. 30, 1912 (Beutenmüller); West Point, N. Y. (Wm. T. Davis).

This species is readily recognized by its pale color, in the female by the form of the subgenital plate, and in the male by the longitudinally oval hammer and the cylindrical subanal lobes with a brush of hairs at their base.

Acroneuria georgiana Banks.

(Plate 15, fig. 4; plate 19, figs. 13-16.)

1914. *Perla georgiana* Banks, Proc. Acad. Nat. Sci. Phil., p. 608.

Length to wing tips, male, 17 mm.; female, 19 mm. Expanse, male, 30 mm.; female, 33 mm.

Color light yellowish brown, abdomen darker and wings very pale. Head yellowish, the clypeus, ocellar triangle and hind angles behind the eye washed with brownish, also the two basal segments of the antennae. Rear ocelli ringed with blackish pigment within, closer to each other than to the eyes. M-mark crossing the frons obscure yellowish. Antennae toward the tips and palpi brownish.

Prothorax almost as wide as the head, very much narrowed rearward, hind margin a little and front margin very convex. Sides nearly straight. There is a wide smooth median area traversed by a rather narrow middorsal yellow stripe. Rugosities on the sides of the disc well marked, rather broad and not numerous. Legs yellowish. Wings and veins pale yellowish brown.

Abdomen olive brown, the segments toward the rear with numerous black spots. Tails yellow, partially covered with hair.

Male. Ninth abdominal sternite medially produced near the hind margin into a triangular percussion

ridge, pointed in the rear and with transverse grooves on its ventral surface; tergites normal, subanal lobes modified into broad triangular subgenital hooks which recurve upon the tenth tergite.

Female. Subgenital plate triangularly produced entirely across ninth sternite, with a median notch.

Distribution.—Type, female, No. 11328, Clayton, Georgia, June, 1909 (Banks Coll., Mus. Comp. Zool., Cambridge); Tallulah Falls, Georgia, June 17; North Carolina.

Family NEMOURIDAE.

This family is characterized by absence of long tails in the adult forms. In Nemoura, Leuctra and Perlomyia the tails or cerci are composed of a single segment which in some instances is modified into an accessory copulatory organ, while in Taeniopteryx the cerci vary, being composed of single segments in some males, of several segments in others and in the female always made up of 3-10 segments. Insects mostly of a dull brown or blackish color. Head usually a little wider than prothorax, with long slender antennae; three small ocelli (except *Taeniopteryx occidentalis* Bks., which has only two); hind ocelli closer to the eyes than to each other. First and third tarsal segments subequal in length; second either very short or as long as the first; second anal vein of forewing forked.

The genitalia are mostly very complicated in the males.

When better known this family, which is of wide distribution, will probably contain the largest number of species of stoneflies. Superficially the species within a genus look very much alike and it is only after thorough relaxation or after boiling of the abdomen in caustic potash that the genital characters are brought out sufficiently for specific determination.

Key to the Genera of Nemouridae.

1. Second tarsal segment about as long as the others; cerci of females composed of three or more segments, of males variable ------*Taeniopteryx*
   Second tarsal segment much shorter than the others; cerci composed of a single segment---- 2
2. An oblique crossvein in the apical marginal space beyond the tip of subcosta; wings not rolled around the body when at rest --------*Nemoura*
   No crossvein beyond the tip of subcosta; wings rolled around the body when at rest --------- 3

3. Rs and M of forewing originate from a common point of the radial base _____*Perlomyia*
Rs of forewing originates from radius apart from M _____ *Leuctra*

Genus NEMOURA Latreille.

1796. *Nemoura* Latreille, Precis, 101.
1832. *Nemoura* Pictet, Ann. Sci. Nat. (Reprint.)
1842. *Nemoura* Pictet, Perlides, 335 and 382.
1842. *Nemoura* Rambur, Ins. Neurop., 459.
1861. *Nemoura* Hagen, Syn. Neurop. N. A., 36.
1894. *Nemoura* Morton, Trans. Ent. Soc. Lond., 500.
1898. *Nemoura* Kempny, Verh. k. k. Zool. bot. Gesell. Wien, p. 13. reprint.
1902. *Nemoura* Ris, Mitt. Schweiz. Ent. Gesell., 10:378-406 (Revision).
1909. *Nemoura* Klapalek, Suesswasserf. Deutschl., 8:69.

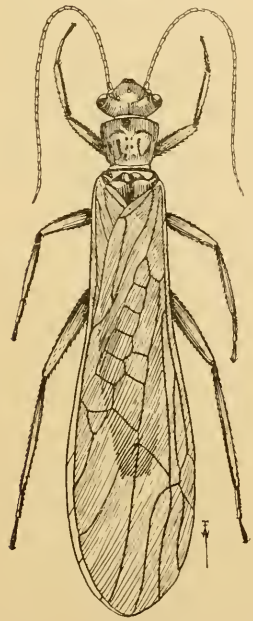

Fig. 25. *Nemoura vallicularis* Wu.

Size small, mostly under 15 mm. in length; color brown or blackish; veins of the pterostigmas in the form of an X; tails absent; second tarsal segment short.

Head as wide as or wider than prothorax; three ocelli, the hind ocelli closer to the eyes than to each other; usually a shallow depression between or just back of hind ocelli.

Prothorax usually wider than long; surface not very rugose; brown or blackish. Legs brown, in some species distinctly banded with yellow; first and third tarsal segments subequal, second tarsal segment short. Wings lie flat on body at rest; anal area of hind wings quite large; the tip of subcosta, the radio-medial crossveins and the base of R4 and R5 together with the radial crossveins form a large X in the pterostigma; there are no crossveins beyond Sc2; radial sector forked but once; Cu1 without accessory branches.

Abdomen brown; cerci composed of a single segment, either membranous or modified into chitinized accessory copulatory organs.

Male. Supra-anal plate prolonged into a process, which either recurves over the abdomen or is directed upwards and backwards; subanal lobes either simple or variously modified into accessory copulatory organs; ninth abdominal sternite prolonged into a subgenital plate which bears (except in *N. punctipennis*) at the base a flap-like appendage, the ventral lobe.

Female. Seventh abdominal sternite either unmodified or produced over the eighth sternite in the form of a subgenital plate; genital opening of the eighth sternite usually guarded by two valves.

Genotype, *Nemoura variegata* Oliv. (Europe).

Under the genus *Nemoura* the European workers (Ris, Kempny, Klapalek, et al.) recognize at least four subgenera: *Protonemoura* Kempny, *Amphinemoura* Ris, *Nemoura* s. str. and *Nemouraella* Kempny. Although it may be possible to group the European species under these subgenera we have been unable to do so with the North American forms, partly because some of the species do not fit into any one of the subgenera, but particularly because the immature stages of only a few species are known. Consequently they are here all placed under the genus *Nemoura* s. lat.

Key to Species of Nemoura.*

Males.

0. Ninth abdominal sternite without a basal ventral lobe ---------- *punctipennis*
   Ninth abdominal sternite with a basal ventral lobe ---------- 1
1. Ninth tergite bearing two large rounded knobs---------- *stigmata*
   Ninth tergite nearly smooth, without distinct knobs ---------- 2
2. Supra-anal process directed backward and upward but not recurved; subgenital plate long and turned up at a right angle---------- 3

*Note.—Since the size, color markings, shape of prothorax, etc., vary considerably in individuals of the same species, the genital structures are used largely in differentiating the species. The genitalia of the males are highly complex and furnish excellent specific characters, but it is necessary in most cases to remove the abdomen and boil and clear it in caustic potash in order that the different parts may be distinguished. Pinned specimens are almost hopeless for determination. The genitalia of the females do not show such striking differences in the different species, and where species have not been reared it is not always easy to connect the males and females properly.

Supra-anal process recurved upon the body; subgenital plate not turned up at a right angle 8

3. 1st A and 2nd A of forewing united before margin of wing ---- 4

1st A and 2nd A of forewing not united before margin of wing ---- *carolinensis*

4. Subanal lobes rather small, in side view flask-shaped; subgenital plate in side view broad---- *vallicularia*

Subanal lobes large, in side view somewhat boot-shaped; subgenital plate in side view narrow-- 5

5. Subanal lobes with a tooth or spine on the upper forward corner ---- *washingtoniana*

Subanal lobes without a tooth or sharp projection ---- 6

6. Outer sheaths of supra-anal process with teeth or serrations ---- 7

No outer sheaths with serrations; the supra-anal process partly membranous; subanal lobes in side view irregularly enlarged at tip---*producta*

7. Subanal lobes (side view) much constricted in the middle and spinulose at the tip---*interrupta*

Subanal lobes (side view) not constricted in middle and not spinulose at tip---- *nevadensis*

8. Cerci heavily chitinized and variously modified into accessory copulatory hooks ---- 9

Cerci membranous and not modified into copulatory hooks ---- 12

9. Cerci on the inside membranous, the chitinous portion armed at the tip with spines; subanal lobes very large and not much modified; subgenital plate and ventral lobes broad and short ---- *trispinosa*

Cerci long, completely chitinized and ending in a sharp point; subanal lobes long and quite slender ---- 10

10. Subgenital plate divided at the tip, each half being serrate on the outer margin; subanal lobes long, slender and near the tip armed with two spurs ---- *serrata*

Subgenital plate entire and smooth; subanal lobes not armed with spines ---- 11

11. Subgenital plate broadly truncate at tip; supra-anal process recurved and not very complicated ---- *truncata*

Subgenital plate greatly prolonged into a slender

pointed process; supra-anal process very complicated _____ *prolongata*

12. Supra-anal process greatly enlarged beyond the base (side view) and largely membranous____ 13
Supra-anal process not enlarged beyond the base (side view) and largely chitinized _____ 16

13. Wings and legs not banded with darker and lighter colors; subanal lobes entire, somewhat prolonged _____ *frigida*
Wings and legs more or less distinctly banded; subanal lobes broad and (ventral view) bearing on the inside a small spine-like appendage ____ 14

14. Supra-anal process armed below with two rows of spines, also with a few spines above_____ _____ *oregonensis*
Supra-anal process unarmed _____ 15

15. Cerci very small; ventral lobe truncate; subanal lobes (side view) with a pointed projection below; small species, 6.5 mm. long_____*columbiana*
Cerci quite large, ventral lobe rounded; subanal lobes (side view) smooth below; larger species 9-10 mm. long _____*cinctipes*

16. Each side of the tenth tergite greatly prolonged backward and armed with spines; ventral lobe as wide as long _____*rotunda*
Sides of tenth tergite not prolonged backward, or if apparently so there are no spines present; ventral lobe at least twice as long as wide_____ 17

17. Subanal lobes (ventral view) unmodified, i. e. evenly rounded _____ 18
Subanal lobes modified (prolonged, bifurcate, divided, etc.) _____ 20

18. Supra-anal process short, broad, truncate at tip, partly membranous, bearing above two chitinous projections _____*delicatula*
Supra-anal process long, slender, pointed and entirely chitinized _____ 19

19. From the base of the supra-anal process, on each side originates a long, slender diverging chitinous process _____*divergens*
No diverging slender chitinous process originating from the base of the supra-anal process___ _____ *glabra*

20. Wings with many (about 30) clear rounded spots disposed over the entire surface, supra-anal

process with spines below ---------- *venusta*
Wings without many clear rounded spots ---------- 21
21. At the base of each cercus is a backward pointing chitinized spine-like process ---------- 22
Base of cercus either with a membranous process, a bluntly chitinized process or else smooth, never a sharp chitinized spine-like process ---------- 23
22. Spine-like process at base of cercus directed backward and about as long as cercus; supra-anal process (dorsal view) not much enlarged beyond base ---------- *cornuta*
Spine-like process at base of cercus directed inward and much shorter than cercus; supra-anal process (dorsal view) much enlarged beyond base ---------- *californica*
23. At base of cercus a large asymmetrical chitinized lobe directed backward and inward ---------- *depressa*
No such blunt chitinized lobe at base of cercus ---------- 24
24. At base of cercus a membranous rounded or elongate lobe ---------- 25
No lobe at base of cercus ---------- 27
25. Membranous lobe at base of cercus rounded; subanal lobes neither bifurcate at tip nor produced into slender flexuous processes ---------- *coloradensis*
Membranous lobe at base of cercus elongate and pointing inward; subanal lobes either bifurcate at tip or produced into slender flexuous processes ---------- 26
26. Subanal lobes ending in slender flexuous processes ---------- *flexura*
Subanal lobes bifurcate at tip and not ending in slender flexuous processes ---------- *biloba*
27. Supra-anal process smooth, subanal lobes divided into two narrow sinuate chitinized bands, the outer one bearing heavy spines near the top ---------- *sinuata*
Supra-anal process spinulose either above or below; subanal lobes not very slender and not armed with heavy spines ---------- 28
28. Supra-anal process with spines below, subanal lobes divided longitudinally, each half bearing groups of heavy hairs ---------- *venosa*
Supra-anal process finely spinulate above; subanal lobes much prolonged and deeply bifurcate at tip ---------- *bifurcata*

Nemoura glabra Claassen.

(Plate 34, figs. 1-4.)

1923. *Nemoura glabra* Claassen, Can. Ent., 55:281.

Length to tip of wings, male, 7 mm.; female, 7.5 mm. Expanse, male, 11 mm.; female, 14 mm.

General color dark brown. Head wider than prothorax; hind ocelli closer to eyes than to each other. Prothorax much wider than long, moderately rugose, widened behind, angles broadly rounded. Wings lightly to rather heavily infuscated, with two indistinct transverse darker bands; anal field of hind wings large. Gills apparently absent.

Male. Subanal lobes entire, unmodified; cerci large, membranous; supra-anal process recurved, long, not much widened, smooth and completely chitinized; subgenital plate short; ventral lobe about twice as long as wide.

Female. Seventh sternite unmodified; eighth sternite not produced but with a suggestion of a slight notch in center.

Holotype male, allotype female, April 30, 1913, Truro, Nova Scotia (Cornell University Collection); one female and male, same locality as type; male and female, March, 1908, Boulder, Colo.; one male, Logan, Utah.

Nemoura frigida Claassen.

(Plate 34, figs. 5-7.)

1923. *Nemoura frigida* Claassen, Can. Ent., 55:285.

Length to tip of wings, male, 7 mm. Expanse, male, 12 mm.

General color dark brown.

Head wider than prothorax, smooth, covered with fine pile; the hind ocelli at least twice as close to eyes as to each other.

Prothorax wider than long, much narrowed behind, quite rugose, uniformly brown, angles quite sharp. Legs uniformly light brown. Wings uniformly subhyaline; anal field of hind wings large. Gills present.

Male. Subanal lobes entire, somewhat produced and broadly truncate behind; cerci membranous and small; supra-anal process recurved, enlarged and largely membranous; subgenital plate only moderately produced; ventral lobe about three times as long as wide.

Female, unknown.

Holotype, male, June 16, 1899, Sitka, Alaska (Harriman Expedition, T. Kincaid); in the National Museum, Washington, D. C.

Nemoura divergens Claassen.

(Plate 34, figs. 8-10.)

1923. *Nemoura divergens* Claassen, Can. Ent., 55:282.

Male. Length to tip of wings, 8.5 mm; expanse, 15 mm.

General color brown. Head not wider than prothorax, brown, occiput quite rugulose; hind ocelli a little closer to eyes than to each other. Prothorax brown, wider than long, widened behind, angles broadly rounded. Legs light brown. Wings subhyaline with a darker band across the cord and somewhat darker at the tip; anal field of hind wings large.

Subanal lobes unmodified; subgenital plate quite short; cerci largely membranous; ventral lobe about twice as long as wide; supra-anal process recurved, smooth, entirely chitinized; each side of the supra-anal process a long, slender, chitinized divergent process.

Female, unknown.

Holotype, male, Mar. 15, Clinton, N. Y. (P. B. Powell, in Cornell University Collection); one male, Apr. 17, Ithaca, N. Y.; one male, Mar. 30, Forest Hills, Mass.

Nemoura columbiana Claassen.

(Plate 34, figs. 11, 12, 13.)

1923. *Nemoura columbiana* Claassen, Can. Ent., 55:286.

Male. Length to tip of wings, 6.5 mm.; expanse, 11 mm.

General color dark brown, with banded wings and legs.

Head wider than prothorax, blackish brown; hind ocelli closer to eyes than to each other. Prothorax blackish brown, slightly rugose, wider than long, narrowed behind; front angles broadly rounded; hind angles almost sharp; sides straight. Legs brown with a light spot or band just beyond the middle on femora. Wings subhyaline, with two dark transverse bands, one at the cord and the other before the tip; anal field of hind wings large. Four single gills present in the cervical region.

Subanal lobes large, curved upward and bearing on the inner margin (ventral view) a curved spine-like process; below (side view) a short triangular process; cerci small, membranous; supra-anal process recurved, short, enlarged, partly membranous; subgenital plate quite short; ventral lobe truncate, a little more than twice as long as wide.

Female, unknown.

Holotype, male, June 25, 1908, between Laggan and the valley of the Ten Peaks, Alberta, Canada (J. C. Bradley, Cornell University Collection).

Nemoura delicatula Claassen.

(Plate 34, figs. 14-17.)

1923. *Nemoura delicatula* Claassen, Can. Ent., 55:285.

Length to tip of wings, male, 6 mm.; female, 7.5 mm. Expanse, male, 10.5 mm.; female, 13.5 mm.

General color light brown. Head much wider than prothorax, brown; hind ocelli closer to eyes than to each other. Prothorax brown, quite rugose; wider than long; angles very broadly rounded. Legs light brown. Wings uniformly hyaline, veins faint; anal area of hind wings narrow. Gills absent.

Male. Subanal lobes slightly, if at all, modified; cerci small, membranous; supra-anal process recurved, broadly truncate at tip, fitting closely into a depressed area at the tenth tergite, partly membranous and bearing above two chitinous projections; the tenth tergite each side with a raised chitinized lobe; subgenital plate rather short; ventral lobe about three times as long as wide.

Female. Seventh sternite not produced posteriorly; eighth sternite unmodified, the genital opening not guarded by valves.

Holotype, male, allotype, female, and 24 paratypes, males and females, from Boulder, Colo. (G. S. Dodds, Cornell University Collection).

Nemoura bifurcata Claassen.

(Plate 34, figs. 18-20.)

1923. *Nemoura bifurcata* Claassen, Can. Ent., 55:282.

Length to tip of wings, male, 9 mm. Expanse, male, 14.5 mm.

General color brown. Head a little wider than prothorax, occiput somewhat rugose; hind ocelli about twice as close to eyes as to each other. Prothorax brown, a little wider than long, hardly narrowed behind; angles rather sharp; surface somewhat rugose. Legs brown. Wings uniformly subhyaline; anal field of hind wings large. Gills apparently absent.

Male. Subanal lobes considerably produced and deeply bifurcate at the tip; cerci membranous; supra-anal process recurved, membranous above and dorsally finely spinulose; subgenital plate rather short; ventral lobe about two and one-half times as long as wide.

Female, unknown.

Holotype, male, 5-15-95, without locality label (Cornell University Collection).

Nemoura biloba Claassen.

(Plate 35, figs. 1-4.)

1923. *Nemoura biloba* Claassen, Can. Ent., 55:282.

Length to tip of wings, male, 8.5 mm.; female, 9 mm. Expanse, male, 17 mm.; female, 18 mm.

General color brown. Head a little wider than prothorax, uniformly brown; hind ocelli about twice as close to eyes as to each other. Prothorax wider than long, somewhat rugose, a little widened behind; angles narrowly rounded. Legs brown, the femora somewhat darker toward the end. Wings uniformly subhyaline; anal field of hind wings large. Gills present.

Male. Subanal lobes prolonged, upcurved and at the tip divided into two slender processes; cerci large membranous; at base of cerci an inward pointing, short, membranous, oblong lobe, suggestive of a second small pair; supra-anal process recurved, slender, membranous above; subgenital plate somewhat prolonged; ventral lobe a little more than twice as long as wide.

Female. Seventh sternite very slightly produced posteriorly; eighth sternite with a narrow median notch.

Holotype male, allotype female, and one paratype, Los Angeles Co., California (Cornell University Collection).

Nemoura flexura Claassen.

(Plate 35, figs. 5-8.)

1923. *Nemoura flexura* Claassen, Can. Ent., 55:284.

Length to tip of wings, male, 6.5-7 mm.; female, 8-9 mm. Expanse, male, 10.5-11 mm.; female, 13-14 mm.

General color brown.

Head wider than prothorax, darker than prothorax; occiput slightly rugose; hind ocelli about twice as close to eyes as to each other.

Prothorax wider than long, narrowed behind, quite rugose, the rugosities rather coarse; angles quite broadly rounded. Legs brown, wings uniformly subhyaline; anal field of hind wings narrow.

Male. Subanal lobes produced into slender flexuous processes which are upturned; cerci membranous; at base of cerci originates a lobe suggestive of a second pair; supra-anal process slender, recurved, membranous above near tip; subgenital plate short; ventral lobe slender, about three times as long as wide.

Female. Seventh sternite somewhat produced, almost tuberculate in the middle; eighth sternite with a deep median notch.

Holotype male, allotype female, Boulder, Colo. (G. S. Dodds, Cornell University Collection); five additional males and eight females, same locality.

Nemoura depressa Banks.

(Plate 32, fig. 6; plate 35, figs. 9-12.)

1898. *Nemoura depressa* Banks, Trans. Am. Ent. Soc., 25:200.
1905. *Nemoura depressa* Banks, Invert. Pacif., p. 87.
1907. *Nemoura depressa* Banks, Can. Ent., 39:329.
1907. *Nemoura depressa* Banks, Cat., p. 14.

Length to tip of wings, male, 7.5-8 mm. female, 9-10 mm. Expanse, male, 15-16 mm.; female, 16-17 mm.

General color reddish brown. Head a little wider than prothorax; hind ocelli at least twice as close to eyes as to each other; antennae brown, darker toward the tip. Prothorax wider than long, slightly narrowed behind, moderately rugose; angles narrowly rounded. Wings subhyaline, with a rusty tinge; anal field of hind wings narrow. Legs reddish brown, femora a little darker toward the tip but not banded. Gills present.

Abdomen reddish brown, somewhat darker toward the tip.

Male. Subanal lobes produced, slightly upcurved and broadly bifurcate at tip (side view) the inner portion of subanal lobe short and somewhat triangular; cerci membranous; at base of cercus a large asymmetrical, chitinized, lobe almost as long as the cercus; supra-anal process recurved, slender, finely spinulose above; subgenital plate short; ventral lobe about two and one half times as long as wide.

Female. Seventh sternite only very slightly produced posteriorly; eighth sternite deeply notched in middle.

Distribution.—Type, female, No. 11359, Sept., Cottage Grove, Ore. (Morse, in Banks Collection, Mus. Comp. Zool., Cambridge, Mass.); in Banks Collection are also one female, Sept., Cottage Grove, Ore.; one female, Sept., Divide, Ore.; two females, Ore.; one female, Aug. 23, Laggan, B. C.

We have specimens as follows: March 8, 1908, Oakland Hills, Alameda Co., Calif. (E. C. VanDyke); March 25, 1919, Monterey Co., Carmel, Calif. (E. C. V. D.); Sept. 4, 1905, Palo Alto, Calif.; April 11, 1919, San Francisco, Calif. (E. P. VanDuzee); May 1, 1921, Fairfax, Marin Co., Calif. (E. C. V. D.).

Nemoura cornuta Claassen.

(Plate 35, figs. 13-15.)

1923. *Nemoura cornuta* Claassen, Can. Ent., 55:285.

Male. Length to tip of wings, 7.5 mm.; expanse, 12.5 mm.

General color brown. Head wider than prothorax; hind ocelli closer to eyes than to each other. Prothorax brown, narrow, a little longer than wide, surface somewhat rugose; sides straight, angles rather narrowly rounded. Legs uniformly brown. Wings uniformly hyaline; anal field and hind wings large. Two groups of gills in the cervical region.

Subanal lobes prolonged into irregular chitinized processes bluntly pointed; cerci membranous; above the cerci a horn-like chitinized process about as long as the cercus; supra-anal process recurved, slender, membranous above, chitinized below; sugenital plate rather short, the tip truncate; ventral lobe slender, about four times as long as wide.

Female, unknown.

Holotype, male, June 22, 1920, Nanaimo, B. C., Biological Station (E. P. Van Duzee). In the Collection of the California Academy of Sciences.

Nemoura californica Claassen.

(Plate 35, figs. 16-19.)

1923. *Nemoura californica.* Claassen, Can. Ent., 55:284.

Length to tip of wings, male, 8 mm.; female, 8.5 mm. Expanse, male, 14.5 mm.; female, 15 mm.

General color brown. Head a little wider than prothorax, uniformly dark brown; hind ocelli at least twice as close to eyes as to each other. Prothorax uniformly brown, wider than long, somewhat narrowed behind, surface nearly smooth, angles rather narrowly rounded. Legs brown. Wings subhyaline; anal field of hind wings narrow. Gills present in four groups of filaments in cervical region.

Male. Subanal lobes wide, produced, upcurved and bearing before the apex a short tooth; cerci membranous; at base of cerci a short inward pointing, chitinous horn; supra-anal process recurved; much widened beyond base, the membranous portion finely spinulose; subgenital plate quite short; ventral lobe narrow, at least three times as long as wide.

Female. Seventh sternite unmodified; eighth sternite

considerably produced with median notch; just before the notch a blunt tubercle.

Distribution.—Holotype, male, March 22, 1908, Oakland Hills, Alameda Co., Calif. (E. C. VanDyke, in the Collection of the California Academy of Sciences); allotype, female, April 6, 1897, Seattle, Wash.; one female, 4-6-97, Seattle, Wash.; one male, May 27, 1903, Fieldbrook, Calif. (H. S. Barber); one female and one male, May 15, 1894, Olympia, Wash.; two males, 20-7-03, Bear Lake, B. C.; one male, Sept. 4, 1891, Bouter's Ranch, Mont.

Nemoura sinuata Wu.

(Plate 36, figs. 1-4.)

1923. *Nemoura sinuata* Wu, Bulletin Lloyd Library No. 23, Entomological Series, No. 3:1-47.*

Length to tip of wings, male, 8-9 mm.; female, 9-10 mm. Expanse, male, 14-14.5 mm.; female, 16-16.5 mm.

General color dark brown. Head wider than prothorax, dark brown; hind ocelli closer to eyes than to each other. Prothorax hardly, wider than long, narrowed behind angles widely rounded. Legs brown, femora sometimes slightly darker in middle. Wings subhyaline, lightly infuscated at stigma; anal field of hind wings small. Four groups of gills in cervical region.

Male. Subanal lobes divided into two narrow chitinous bands, the inner smooth, unarmed and only about half as long as the outer, which is long sinuate and armed with spines, and ends in a sharp point; cerci large, membranous and borne on a narrow chitinous band, the basipodite; subgenital plate not much prolonged; ventral lobe narrow, about three times as long as wide.

Female. Seventh sternite not produced; eighth sternite heavily chitinized in center and somewhat produced, with a deep median notch.

Distribution.—Holotype, male, allotype, female, June Ithaca, N. Y. (Cornell University Collection). Many specimens, males and females, June to August, Ithaca, N. Y., and vicinity; July 5, 1918, Newcomb, N. Y.; July-Aug., Old Forge, N. Y.; June 13, 1910, Gloversville, N. Y.; Etna, Tompkins Co., N. Y.; McLean, Tompkins, Co., N. Y.; July 1, 1923, Alcohol Brook, Adirondack Lodge, N. Y.; March 18-21, 1911, Barton, Ga.; June, 1912, Black Mts., N. C. Beutenmüller); July 18, 1919, Mt. Mitchell, N. C. (R. W. Leiby); June 26, 1920, Cranberry Lake, N. Y. (C. J. Drake); Greene Co., N. Y.

*This species is described by Wu in footnotes in the above cited paper. He also figures the genitalia.

Nemoura venusta Banks.

(Plate 36, figs. 5-8.)

1911. *Nemoura venusta* Banks, Trans. Am. Ent. Soc., 37:337.

Length to tip of wings, male, 7-7.5 mm.; female, 8.5-10 mm. Expanse, male, 12-13 mm.; female, 14-18 mm.

General color dark brown. Head wider than prothorax; hind ocelli at least twice as close to eyes as to each other. Prothorax almost as long as wide, hardly narrowed behind, angles rather broadly rounded. Wings infuscated but with about thirty clear rounded spots distributed quite regularly over the entire wing; anal field of hind wings narrow. Gills present.

Male. Subanal lobes divided into two unequal chitinized bands, the outer lobe only about half as long as the inner which is membranous on the inside; both bands are armed with stout spines; cerci membranous; supra-anal process recurved, armed with spines underneath; subgenital plate rather short; ventral lobe narrow, about four times as long as wide.

Female. Seventh sternite produced over entire eighth segment as a large broadly rounded subgenital plate; genital opening of eighth sternite guarded by two short, truncate lobes.

Type, female, No. 11357, Huachuca Mts., Ariz. (Banks Collection, Mus. Comp. Zool., Cambridge, Mass.); Boulder, Colo. (G. S. Dodds); Aug. 10, 1919, Estes Park, Colo. (P. W. Claassen).

Nemoura venosa Banks.

(Plate 36, figs. 9-12.)

1891. *Nemoura venosa* Banks, Trans. Am. Ent. Soc., 24:21.
1904. *Nemoura venosa* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Nemoura venosa* Banks, Cat. Neurop., p. 14.
1920. *Nemoura stylata* Banks, Bull. Mus. Comp. Zool., 64:324.

Length to tip of wings, male, 7 mm.; female, 7.5 mm. Expanse, male, 12 mm.; female, 13.5 mm.

General color blackish brown. Head blackish, wider than prothorax, hind ocelli closer to eyes than to each other. Prothorax quadrangular, little wider than long, hardly narrowed behind; angles rounded. Wings quite heavily infuscated, sometimes almost black; anal field of hind wings narrow.

Male. Subanal lobes divided into two chitinized upcurved bands, the inner longer and at the tip membranous on the inside, both bands armed with spines; cerci membranous; supra-anal process recurved, armed underneath with heavy spines; subgenital plate not much produced; ventral lobe at least three times as long as wide.

Female. Seventh sternite produced into a broadly rounded subgenital plate which covers at least half of the following segment; eighth sternite notched in middle, the genital opening guarded by two rounded valves.

Distribution.—Cotypes, No. 11361 ♀ and two ♂'s, Colden, N. Y., July 6, 1895 (Banks Collection Mus. Comp. Zool., Cambridge, Mass.).

The Banks Collection also contains the following: one female, June 5, Chain Bridge, Va.; one female, June 25, Great Falls, Va.; one female, Aug., Aurora, W. Va.

We have specimens from the following localities: June 29, Ringwood, Tompkins Co., N. Y.; May 21, Enfield Glen, Tompkins Co., N. Y.; June 2, 1923, McLean, Tompkins Co., N. Y.; June 1, 1905, West Danby, N. Y. (A. D. MacGillivray); May 29, 1902, Newport, N. Y.; June 22, 1910, Woolworth Lake, Fulton Co., N. Y. (C. P. Alexander); July 1, 1923, Alcohol Brook, Adirondack Lodge, N. Y. (P. W. Claassen); June 26, 1905, Old Forge, N. Y. (J. G. Needham); June 26, 1920, Cranberry Lake, N. Y. (C. J. Drake); May 21, 1911, Barton, Ga. (J. C. Bradley); May 18, 1911, Clayton, Ga. (J. C. Bradley); May 29-June 5, Raleigh, N. C.; June 28, 1903, Lake Forest, Ill. (J. G. Needham); June 18, 1888, Waltham, Mass. (S. Henshaw); June 14, N. Adams, Mass.; Sept. 8, 1889, Port Arthur, Ont.; Penn.

Nemoura coloradensis Banks.

(Plate 36, figs. 13-16.)

1897. *Nemoura coloradensis* Banks, Trans. Am. Ent. Soc., 24:2.
1907. *Nemoura coloradensis* Banks, Cat., p. 14.

Length to tip of wings, male, 8.5-9.5 mm.; female, 10-10.5 mm. Expanse, male, 14-15 mm.; female, 15-16 mm.

General color blackish brown.

Head not wider than prothorax; hind ocelli closer to eyes than to each other; antennae blackish.

Prothorax slightly wider than long, moderately rugose; angles narrowly rounded. Legs dark brown, the femora darker toward the tip, but not banded. Wings lightly infuscated and somewhat darker at the stigma; anal field of hind wings narrow. Gills present.

Male. Subanal lobes produced, upcurved and bluntly pointed (side view); viewed from below the subanal lobes are divided into two parts, the inner short truncate, the outer longer, upcurved; cerci large membranous; above base of cercus is a rounded, membranous, hairy knob; supra-anal process recurved, slender, finely spinulose

above; subgenital plate not much produced; ventral lobe about three times as long as wide.

Female. Seventh sternite slightly produced in middle, eighth sternite with a deep median notch; ninth sternite with a dark spot each side.

Distribution.—Type, male, No. 11358, from Colorado (Banks Collection Mus. Comp. Zool., Cambridge, Mass.).

The following additional specimens are in the Banks Collection; one female, July 29, 1907, one male, July 23, 1907, one female, July 27, two females, Aug. 5, 1907, Florissant, Colo. (S. A. Rohwer); one male, June 10, Fort Collins, Colo.; one male, Aug. 12, 1907, Chimney Gulch, Golden, Colo.; one female, Aug. 22, 1907, Boulder, Colo. (S. A. Rohwer).

We have specimens from the following localities: June 27 to July 8, 1906, Florissant, Colo. (T. D. A. Cockrell); Manitou, Colo., 1877 (Morrison).

Nemoura producta Claassen.

(Plate 37, figs. 1-4.)

1923. *Nemoura producta* Claassen, Can. Ent., 55:286.

Length to tip of wings, male, 11 mm.; female, 11.5 mm. Expanse, male, 20 mm.; female, 21 mm.

General color brown to blackish brown. Head wider than prothorax nearly smooth; hind ocelli a little closer to eyes than to each other. Prothorax wider than long, slightly narrowed behind; angles quite sharp. Legs brown, not banded. Wings subhyaline; 1st A and 2nd A of forewing united before margin; anal field of hind wings large. Gills apparently absent.

Male. Subanal lobes broad, produced, upcurved and enlarged at tip (side view), on the inside (ventral view) armed with a stout spine-like process; cerci small, membranous; supra-anal process bent up but not recurved, with chitinous structures surrounded by a finely spinulose membrane; subgenital plate long, narrow; ventral lobe about three times as long as wide.

Female. Seventh sternite produced into a narrow, evenly rounded subgenital plate which reaches across most of segment eight; eighth sternite unmodified.

Holotype, male, allotype, female, without any label. Cornell University Collection.

Nemoura cinctipes Banks.

(Plate 32, fig. 2; plate 37, figs. 5-8.)

1897. *Nemoura cinctipes* Banks, Trans. Am. Ent. Soc., 24:21.
1907. *Nemoura cinctipes* Banks, Can. Ent., 39:329.
1907. *Nemoura cinctipes* Banks, Cat., p. 14.

Length to tip of wings, male, 9.5-10 mm.; female, 13 mm. Expanse, male, 15-16 mm.; female, 22-24 mm.

General color blackish brown, with banded legs and wings.

Head a little wider than prothorax; hind ocelli closer to eyes than to each other; antennae brown.

Prothorax dark brown, surface slightly rugose, wider than long, narrowed behind, angles broadly rounded. Legs dark brown, femora with a yellow band beyond the middle. Wings with three transverse dark bands, one at the tip, another midway between the cord and tip and the third extending more or less across the entire cord (sometimes the entire forewings quite heavily infuscated, especially along the veins), anal field of hind wings large. Four groups of gills present.

Male. Subanal lobes very broad, truncate, on inner margin with a short spine-like process; cerci large membranous, with a narrow chitinized collar or basipodite; supra-anal process recurved, much enlarged (side view), largely membranous and spinulose on the outer halves; subgenital plate moderately produced; ventral lobe about three times as long as wide.

Female. Seventh sternite produced over the entire eighth segment as a broadly rounded subgenital plate; eighth sternite unmodified.

Distribution.—Type, female, No. 11363, Olympia, Wash. (in Banks Collection, Mus. Comp. Zool., Cambridge, Mass.).

The Banks Collection also contains specimens as follows: two females, one male, Olympia, Wash.; two males, two females, Wellington, B. C.; two females, April 30, and May 1, Bon Acord, B. C.; one male, one female, March 27, 1902, Coldstream, B. C.; one female, July 3, 1901, Port Renfrew, B. C.

We have specimens from the following localities: July 1-3, 1915, Maligne Lake, Alberta, Can. (E. L. Diven); June 22, 1908, Banff, Alberta, Can. (J. C. Bradley); July 17, 1908, Selkirk Mts., B. C. (J. C. Bradley); July 12-18, 1908, Carbonate to Prairie Hills, B. C. (J. C. Bradley); March, 1923, Terrace, B. C. (Mrs. W. W. Hippisley); March 31-April 3, 1915, Nisqually Glacier, Mt. Rainier,

Wash. (J. C. Bradley); March-June, Seattle, Wash.; April-May, Olympia, Wash. (Trever Kincaid); July 15, 1920, Paradise Valley, Mt. Rainier, Wash.; May 20, 1921, Yosemite Valley, Calif. (E. C. VanDyke); June 16, 1911, Hills back of Oakland, Calif. (E. C. VanDyke); July 7, 1916, Eldorado Co., Calif. (A. C. Brown); Aug. 3, 1921, Fern Lake, Estes Park, Colo. (P. W. Claassen); Boulder, Colo. (G. S. Dodds); June 25, 1913, Long's Peak Trail, Colo. (T. D. A. Cockerell).

Nemoura oregonensis Claassen.

(Plate 37, figs. 9-11.)

1923. *Nemoura oregonensis* Claassen, Can. Ent., 55:288.

Length to tip of wings, male, 9.5 mm. Expanse, male, 16 mm.

General color brown with banded legs and wings. Head wider than prothorax, brown, with a black spot beside the eyes just in front of hind ocelli; rest of head somewhat mottled; hind ocelli closer to eyes than to each other. Prothorax brown, quite rugose; the rugosities blackish; wider than long, narrowed behind; angles very broadly rounded. Legs dark brown; femora with a light transverse band just beyond the midlle. Wings infuscated, with a light transverse band before the cord and one beyond; anal field of hind wings large. Four finger-like gills in the cervical region.

Male. Subanal lobes very wide, almost as wide as long, truncate, and bearing on the inside (ventral view) a small tooth; cerci short, membranous; supra-anal process recurved, greatly enlarged, partly membranous, armed below with a double row of spines, above also with a few spines; subgenital plate short; ventral lobe truncate, about two and one-half times as long as wide.

Female. Unknown.

Holotype, male, June 21, 1922, Blitzen Valley, Harney Co., Ore. (W. J. Chamberlin, Cornell University Collection).

Nemoura trispinosa Claassen.

(Plate 37, figs. 12-15.)

1923. *Nemoura trispinosa* Claassen, Can. Ent., 55:289.

Length to tip of wings, male, 8.5 mm.; female, 9 mm. Expanse, male, 14.5 mm.; female, 16.5 mm.

General color blackish brown. Head considerably wider than prothorax; hind ocelli about twice as close to eyes as to each other. Prothorax slightly rugose, wider than

long, narrowed behind; angles widely rounded. Wings uniformly subhyaline; anal field of hind wings large. Gills apparently absent.

Male. Subanal lobes wide, entire, with hind margin broadly bilobed; cerci greatly modified into accessory copulatory organs, the outer half heavily chitinized and terminating in three spines, the inner portion membranous; supra-anal process recurved, much enlarged, largely membranous, and below, armed with small spines; subgenital plate short; ventral lobe broad, truncate, about one-half times as long as wide.

Female. Seventh sternite produced into a broadly rounded subgenital plate which covers most of segment eight; eighth sternite unmodified.

Holotype, male, allotype, female, June 17-20, 1904, Mud Creek, Tompkins Co., N. Y., Cornell University Collection.

One male, Murray Bay, Province of Quebec, July or August, 1878 (E. Corning, Jr.); June 2, 1923, McLean, Tompkins Co., N. Y.

Nemoura similis Hagen.

(Plate 37, fig. 16.)

1861. *Taeniopteryx similis* Hagen, Syn. Neur. N. A., p. 34.
1907. *Nemoura similis* Banks, Cat. Neur., p. 14.

Length to tip of wings, female, 8.5 mm. Expanse, female, 16 mm.

General color black.

Head shiny black, wider than prothorax; hind ocelli about twice as close to eyes as to each other.

Prothorax black, very rugose; considerably widened posteriorly, wider than long; front angles very broadly rounded, hind angles narrowly rounded. Wings with three transverse dark bands, one at the apex, one across the cord and a wide band at the base.

Abdomen dark brown. Gills apparently absent.

Female. Seventh sternite unmodified; eighth sternite somewhat produced, with a shallow median notch.

Male unknown.

Type, female, No. 252, May, Washington, D. C. (Osten Sacken, in Hagen Collection, Mus. Comp. Zool., Cambridge, Mass.).

We have not been able to find any males which can be definitely placed with this female.

Nemoura vallicularia Wu.

(Plate 38, figs. 1-4.)

1923. *Nemoura vallicularia* Wu, Bulletin Lloyd Library No. 23, Entomological series No. 3:1-47.*

Length to tip of wings, male, 11 mm.; female, 12.6 mm. Expanse, male, 17.5 mm.; female, 19.5 mm.

General color blackish brown. Head a little wider than prothorax; hind ocelli little closer to eyes than to each other; antennae dark brown. Prothorax dark brown, somewhat lighter on sides; wider than long; slightly narrowed behind; angles broadly rounded. Legs yellowish brown. Wings uniformly smoky; 1st A and 2nd A of forewing united before margin; anal field of hind wings large. Gills absent.

Male. Subanal lobes, as viewed from side, flask shaped, recurved over body, truncate at tip; cerci very small, membranous; supra-anal process not recurved but directed upward and slightly backwards; subgenital plate rather narrow, long and turned up at right angles; ventral lobe about two and one-half times as long as wide.

Female. Seventh sternite produced over entire eighth segment into a narrow subgenital plate which is evenly rounded behind; eighth sternite unmodified; ninth sternite with a small round blackish spot each side.

Distribution.—Holotype, male, allotype, female, Ithaca, N. Y. Cornell University Collection. Many males and females, April and May, Ithaca, N. Y., and vicinity; June 20, Monmouth, Me. (C. A. Frost); March 28, Mosholu, N. Y.; March 6, 1902, Nassau, N. Y.; March 31, 1902, Ilion, N. Y.; April 10, 1903, Clinton, N. Y.; April 14, Riverton, N. J.; 1877, Morganton, N. C. (Morrison); May, 1912, Sunburst, N. C. (F. Sherman).

Nemoura carolinensis Claassen.

(Plate 38, figs. 5-7.)

1923. *Nemoura carolinensis* Claassen, Can. Ent., 55:287.

Length to tip of wings, male, 9 mm. Expanse, 16 mm.

General color brown. Head wider than prothorax, uniformly brown; hind ocelli closer to eyes than to each other. Prothorax wider than long, uniformly brown, slightly rugulose, considerably narrowed behind, angles narrowly rounded. Legs uniformly brown. Wings uniformly subhyaline; anal field of hind wings narrow. Gills apparently absent.

*This paper contains, besides the technical description, a very complete account of the morphology, anatomy and biology.

Subanal lobes entire, greatly enlarged, curved upward and in side view shaped somewhat like a boot; cerci small, membranous; supra-anal process produced backward and upward, the outer sheaths membranous and finely spinulose; subgenital plate much produced and bent upwards; ventral lobe about twice as long as wide.

Female. Unknown.

Holotype, male, 1877, Morgantown, N. C. (Morrison, in the Museum of Comparative Zoology, Cambridge, Mass.).

Nemoura nevadensis Claassen.

(Plate 38, figs. 8-11.)

1923. *Nemoura nevadensis* Claassen, Can. Ent., 55:286.

Length to tip of wings, male, 10.5-11 mm.; female, 14.5-15 mm. Expanse, male, 17-18 mm.; female, 22-24 mm.

General color dark brown. Head a little wider than prothorax; lateral tubercles large; hind ocelli closer to eyes than to each other. Prothorax dark brown, somewhat lighter on the lateral and anterior margins; wider than long; somewhat narrowed behind; front angles narrowly rounded, hind angles more broadly rounded. Legs brown. Wings subhyaline, veins heavy, somewhat infuscated at the stigma; 1st and 2nd A of front wings united before the margin; anal field of hind wings large. Gills absent.

Male. Subanal lobes very large, upcurved, the tip slightly truncate, cerci very small, membranous; supra-anal process produced backward and upward, the outer sheaths wide and bearing spines on upper and lower margin; inner sheaths slender, unarmed; subgenital plate very long, upcurved, with many transverse ridges before the tip; ventral lobe large, about twice as long as wide.

Female. Seventh sternite produced over the entire eighth segment as an evenly rounded subgenital plate; eighth sternite unmodified.

Distribution.—Holotype, male, allotype, female, 1878, Reno, Nev. (Morrison, in the Museum of Comparative Zoology, Cambridge, Mass.).

One female, Eureka, Calif., May 22 (H. S. Barber); one male, Yosemite Valley, Calif., May 24, 1921 (E. C. VanDyke); one female, Tenino, Wash. (H. G. Hubbard); one female, Sausalito, Calif., May, 1913 (J. C. Thompson).

Nemoura washingtoniana Claassen.

(Plate 38, figs. 12-15.)

1923. *Nemoura washingtoni* Claassen, Can. Ent., 55:287.

Length to tip of wings, male, 9.5-10 mm.; female, 11 mm. Expanse, male, 16-17 mm.; female 19 mm.

General color dark brown. Head a little wider than prothorax, uniformly brown; hind ocelli closer to eyes than to each other. Prothorax much wider than long, smooth, somewhat narrowed behind; front angles broadly rounded, hind angles subacute. Wings uniformly subhyaline except for a slight infuscation at the stigma; 1st and 2nd A of forewing united before the margin; anal area of hind wing large. Gills apparently absent.

Male. Subanal lobes very large, narrowed at base, upcurved and produced into a triangular process at the upper inner angle; cerci very small, membranous. Supraanal process not recurved but produced backward and upward, composed of a double sheath on each side, the inner sheaths broad and armed with spines above, the outer sheaths slender and unarmed; subgenital plate long, very hairy and turned up at a right angle; ventral lobe large, about twice as long as wide.

Female. Seventh sternite produced backward into a rounded subgenital plate which reaches beyond the hind margin of segment eight; genital opening not guarded by distinct valves.

Holotype, male, June 15, 1877, Mt. Washington, N. H. (Cornell University Collection); allotype, female, June 16, 1916, Glen House, N. H. (C. W. Johnson); two females, June 14-16, 1916, Glen House, N. H. (C. W. Johnson).

Nemoura interrupta Claassen.

(Plate 38, figs. 16-18.)

1923. *Nemoura interrupta* Claassen, Can. Ent., 55:288.

Length to tip of wings, male, 11.5 mm.; expanse, 19 mm.

General color dark brown. Head wider than prothorax, covered with rather long hair; hind ocelli closer to eyes than to each other.

Prothorax wider than long, somewhat narrowed behind; slightly rugose; angles quite sharp. Legs uniformly brown. Wings subhyaline, first and second A of forewing united before margin; anal field of hind wings large. Gills apparently absent.

Male. Subanal lobes prolonged and curved up at right angles, constricted near the middle, the lobe beyond

evenly rounded and very finely spinulose; cerci small, membranous; supra-anal process directed upwards and backwards, the outer sheaths with a dentate margin above; subgenital plate quite narrow, considerably prolonged, turning up almost at a right angle, ventral lobe about twice as long as wide.

Female, unknown.

Holotype, male, April 4, 1898, Seattle, Wash. (Cornell University Collection).

Nemoura truncata Claassen.

(Plate 39, figs. 1-3.)

1923. *Nemoura truncata* Claassen Can. Ent., 55:290.

Male. Length to tip of wings, 7 mm.; expanse, 12.5 mm.

General color brown. Head wider than prothorax, uniformly brown, covered with fine pile; hind ocelli closer to eyes than to each other. Prothorax uniformly brown, somewhat rugulose, wider than long, slightly widened behind, angles rather broadly rounded. Legs uniformly pale brown. Wings hyaline; anal field of hind wings large. Gills apparently absent.

Subanal lobes entire, modified into slender pointed processes which reach to the end of the subgenital plate; cerci large, chitinized, bent inward at the tip and ending in a sharp point; supra-anal process recurved, closely appressed upon the tergum, much widened toward the tip and above with a small pointed tubercle; subgenital plate arising from about the middle of the ninth sternite, broadly truncate at the tip; ventral lobe small, about twice as long as wide.

Female, unknown.

Holotype, male, May 13, 1879, Walden, Mass. (S. Henshaw, in the Museum of Comparative Zoology, Cambridge, Mass.).

Nemoura serrata Claassen.

(Plate 39, figs. 4-6.)

1923. *Nemoura serrata* Claassen Can. Ent., 55:289.

Male. Length to tip of wings, 7 mm.; expanse, 12.5 mm.

General color dark brown.

Head wider than prothorax, occiput mottled with darker brown; hind ocelli nearly twice as close to eyes as to each other. Prothorax wider than long, sides straight, not narrowed behind; surface moderately rugose; front angles broadly rounded, hind angles sharp. Legs uniformly lighter brown. Wings uniformly subhyaline; anal field of hind wings narrow. Gills apparently absent.

Subanal lobes entire, modified into slender processes which are armed near the tip with two sharp triangular spines; cerci long, chitinized, bent inward and ending in a sharp point; supra-anal process very wide, curved upward and (side view) bifurcate at tip; subgenital plate arising from about the middle of the ninth sternite, narrow, divided at the tip, each half serrate on the outer margin; ventral lobe nearly three times as large as wide.

Female, unknown.

Holotype, male, June 8, 1921, Bar Harbor, Me. (C. W. Johnson); one male, June 3, 1920, Cranberry Lake, N. Y. (C. J. Drake, in Cornell University Collection).

Nemoura prolongata Claassen.

(Plate 39, figs. 7-10.)

1923. *Nemoura prolongata* Claassen Can. Ent., 55:289-290.

Length to tip of wings, male, 7.3 mm.; female, 8.3 mm. Expanse, male, 12.5 mm.; female, 14.5 mm.

General color dark brown. Head very much wider than prothorax, nearly uniformly brown, rather thickly clothed with short hairs, hind ocelli closer to eyes than to each other. Prothorax dark brown, somewhat lighter toward the lateral margins; little wider than long; hardly narrowed behind; angles rounded. Legs uniformly brown. Wings uniformly subhyaline. Gills aparently absent.

Male. Subanal lobes undivided and prolonged into long, slender, somewhat membranous processes; supra-anal process turned up but not recurved, very complex, the outer lobes membranous and armed with spines, the central portion chitinized and armed with large spine-like processes; cerci very long, chitinized and bent upward and inward; subgenital plate narrow, very long and curved upward; ventral lobe narrow, at least three times as long as wide.

Female. Seventh sternite produced into a subgenital plate, reaching across the eighth sternite; genital opening not guarded by valves.

Holotype, male, June 26, 1913, Bretton Woods, N. H. (C. W. Johnson); allotype, female, Orono, Me. (Cornell University Collection); one male, one female, Orono, Me.

Nemoura rotunda Claassen.

(Plate 39, figs. 11-14.)

1923. *Nemoura rotunda* Claassen, Can. Ent., 55:290.

Length to tip of wings, male, 7-7.5 mm.; female, 10-11 mm. Expanse, male 11-12 mm.; female 14-15 mm.

General color dark brown.

Head much wider than prothorax; hind ocelli closer to eyes than to each other. Prothorax quadrangular, very little wider than long, slightly narrowed behind, quite rugose; angles rather narrowly rounded. Wings subhyaline, with two transverse darker bands; anal field of hind wings large. Gills apparently absent.

Male. Subanal lobes hardly modified; cerci membranous; inserted low on the side; just above each cercus a large chitinous process, covered with heavy spines, produced backward and inward; supra-anal process short enlarged, ending in complex lobes and chitinizations; subgenital plate short; ventral lobe circular, about as wide as long.

Female. Seventh sternite unmodified; eighth sternite somewhat swollen in middle and slightly produced into a subgenital plate.

Holotype, male, allotype, female, April, Waldeboro, Me. (Cornell University Collection); June 4 and April 25, Waldeboro, Me.; one male, March-May, Waldeboro, Me. (J. H. Lowell); one male, March 12, Orono, Me.

Nemoura stigmata Banks.

(Plate 39, figs. 15-17.)

1900. *Nemoura stigmata* Banks, Trans. Am. Ent. Soc., 26:244.
1907. *Nemoura stigmata* Banks, Cat. Neurop., p. 14.

Length to tip of wings, male, 16 mm. Expanse, male, 28 mm.

General color dark brown. Head a little narrower than prothorax; nearly uniformly dark brown except for a small lighter depressed area between the hind ocelli and the eyes; hind ocelli twice as close to eyes as to each other; antennae dark brown.

Prothorax wider than long, somewhat widened behind; front angles narrowly rounded, hind angles quite sharp; surface hardly rugose; a darker longitudinal band each side of the median line. Legs brown; femora darker at the tip. Wings subhyaline with an elongate dark spot beyond the stigma.

Male. Ninth sternite with two prominent rounded knobs; subanal lobes modified into very long, slender, chitinous, processes which recurve over the abdomen where they fit into the supra-anal process which also recurves and is chitinized; cerci long and slender but not strongly chitinized; subgenital plate not much produced; ventral lobe heavily chitinized and spine-like.

Female. Unknown.

Type, male, No. 11360, Winnipeg, June 17 (Banks Collection, Museum of Comparative Zoology, Cambridge, Mass.).

Nemoura punctipennis Claassen.

(Plate 32, fig. 3; plate 39, figs. 18-20.)

1923. *Nemoura punctipennis* Claassen, Can. Ent., 55:291.

Length to tip of wings, male, 6.5 mm.; female, 6.5-7.5 mm. Expanse, male, 11.5 mm.; female, 11.5-13 mm.

General color black with banded legs and spotted wings.

Head black, wider than prothorax, feebly pilose; a depression in the ocellar triangle; hind ocelli a little closer to eyes than to each other; eyes large.

Prothorax blackish, wider than long, not narrowed behind; surface irregular but not very rugose. Meso and metathorax blackish. Legs dark brown, femora with a light transverse band near the tip, especially pronounced in the hind femora; first tarsal segment long, about as long as two and three together, second tarsal segment a little shorter than the third. Wings with heavy brown veins; infuscated along the costal margin between costa and radius, a transverse band at the cord and a lighter band beyond the cord; anal area of hind wings large.

Abdomen yellowish brown except the tip which is darkly chitinized (8, 9 and 10 in the male, and 9 and 10 in the female).

Male. Subanal lobes small, rounded behind and unmodified. Supra-anal process recurved over the abdomen, heavily chitinized underneath, broad at the base, tapering to a slender point, cleft in the middle with a membrane on top and two rearward pointing spines behind. Cerci composed of one chitinized segment. Subgenital plate short, pointed and without ventral lobe at the base; tenth tergite depressed in the middle with a raised knob on each side.

Female. Seventh sternite produced posteriorly over eighth sternite which is unmodified; genital opening not guarded by distinct valves.

Distribution.—Holotype, male, allotype, female, June 12-22, 1901, Adirondack Mts., Axton, N. Y. (A. D. McGillivray and C. O. Houghton, in Cornell University Collection); two females, June 12-22, 1901, Adirondack Mts., Axton, N. Y. (same collectors); one female, Old Forge, N. Y., June 26, 1905; one female, Tim Pond Plantation, Me., June 22.

Genus LEUCTRA Stephens.

1836. *Leuctra* Stephens, Ill. Mand., 6:145.
1842. *Leuctra* Pictet, Perlides, p. 363.
1861. *Leuctra* Hagen, Syn. Neurop. N. A., p. 37.
1894. *Leuctra* Morton, Tr. Ent. Soc. Lond., p. 559.
1898. *Leuctra* Kempny, Verh. K.-K. Zool-bot. Gesell. Wien.
1907. *Leuctra* Banks, Cat. Neurop., p. 14.
1909. *Leuctra* Enderlein, Zool. Anz., 34:394.

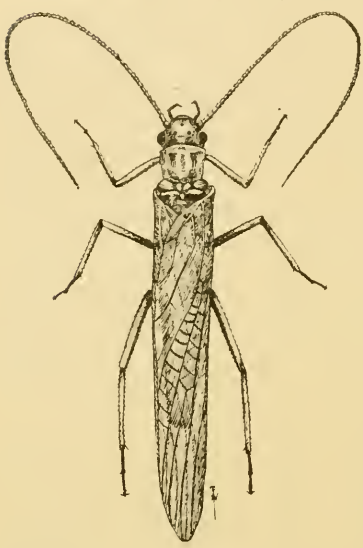

Fig. 26. *Leuctra hamula* Clsn.

Size small, seldom over 10 mm. long; second tarsal segment very short; cerci composed of a single segment; wings involute at rest, uniformly hyaline or smoky, never banded; subcosta runs out to the costal margin, and at the tip, or just before, drops down a vein (Sc2) to radius at right angles; radial sector forked but once, the single fork originating at or before the cord; no M-Cu crossveins beyond the cord; several Cu crossveins beyond the cord; Cu1 of forewing without accessory branches; Cu1 of hind wing forked; radial sector of hind wings originates from the same crossveins from which media springs; anal field of hind wing narrow.

Male. Ninth sternite produced into a short subgenital plate which usually bears a short hairy ventral lobe near the base; supra-anal process small, triangular or rounded and sometimes bent under the tenth tergite; cerci either unmodified or heavily chitinized and armed with hooks or spines; subanal lobes produced into slender chitinous processes and lying just outside of each of these lobes there is usually another more slender, pointed chitinous process (titillator of Klapalek). These titillators in all probability are parts of the subanal lobes; seventh and eighth tergites often with chitinous hooks or processes, which furnish excellent specific characters.

Female. Seventh abdominal sternite unmodified; eighth sternite usually bearing a distinct, notched subgenital plate.

Genotype, *Leuctra geniculata* Steph., European.

Distribution.—Generally distributed over the United States and Canada.

Key to the Species of Leuctra.

Males.

1. Cerci modified into large, chitinized, accessory copulatory organs, armed with hooks or spines 2
   Cerci unarmed ---------- 3
2. Subgenital plate deeply emarginate behind; probe (modified subanal lobes) slender, with a large membranous bulb at tip---------*bradleyi*
   Subgenital plate only slightly emarginate behind, probe not enlarged into a bulb at tip---------- ---------- *occidentalis*
3. Seventh and eighth abdominal tergites smooth, titillators either absent, or when present, recurved upon the abdomen and not in close proximity to the subanal lobes ---------- 4
   Either the seventh or eighth abdominal tergites, or both, with raised chitinous plates or processes except *decepta* which seems to vary considerably in this character; titillators always present and lying in close proximity to the subanal lobes ---------- 5
4. Titillators and ventral lobe absent ---------*glabra*
   Titillators and ventral lobe present, the former recurved; subanal lobes sword-shaped; cerci at least four times as long as wide-------
5. Seventh and eighth abdominal tergites each with two short raised triangular chitinous processes ---------- *duplicata*
   Not so ---------- 6
6. Only the seventh tergite with raised chitinous process ---------- 7
   Only the eighth tergite with raised chitinous process ---------- 10
7. Chitinous process of seventh tergite long, slender, truncate, much longer than wide and reaching across entire seventh tergite and well upon the eighth ---------- *tenuis*
   Chitinous process of seventh tergite short, wide, as wide or wider than long ---------- 8
8. Chitinous process of seventh tergite much wider than long, hind margin rounded; reaching not

more than half way across seventh tergite____ _____ *hamula*

Chitinous process about as wide as long and reaching across entire seventh tergite _____ 9

9. Chitinous process spatulate, gradually drawn to a point in the middle; titillators about as long as subanal lobes; ventral lobe wider than long; length, 8.5 mm. _____*carolinensis*

Chitinous process more or less trilobed; titillators shorter than subanal lobes; ventral lobe about as wide as long; length, 6.5 mm. _____*triloba*

10. Eighth abdominal tergite with a single chitinous process _____ 11

Eighth abdominal tergite with two chitinous processes or a single bifurcate process_____ 12

11. Chitinous process of eighth tergite short truncate _____ *truncata*

Chitinous process of eighth tergite rounded, and hardly raised _____ *decepta*

12. Eighth abdominal tergite with two slender, finger-like processes, widely separate and each several times as long as wide_____*sibleyi*

Eighth abdominal tergite with a raised, bifurcate, chitinous process _____ 13

13. Chitinous process short, not reaching more than half way across the eighth tergite; the lobes broadly truncate _____*biloba*

Chitinous process reaching to hind border of eighth tergite; the lobes sharply triangular___ _____ *grandis*

Leuctra augusta Banks.

(Plate 42, fig. 1.)

1907. *Leuctra augustus* Banks, Can. Ent., 39:330.

Length to tip of wings, female, 10 mm.; expanse, 18 mm. General color very dark brown or black. Head wider than prothorax, black, covered with whitish pile; hind ocelli about three diameters distant from eyes. Prothorax much narrower than head; as long as wide, blackish; narrowed behind; angles rounded; median longitudinal field about one-fourth the width of entire pronotum; disc of pronotum very slightly rugose. Legs brown. Wings rusty; 2 to 4 Cu crossveins beyond M-Cu crossveins.

Male. Unknown.

Female. The abdomen of the first type specimen, No. 11368, in the Museum of Comparative Zoology, is gone.

The second specimen is badly shrivelled but the eighth abdominal sternite apparently is but slightly produced and broadly emarginate in the middle.

Type No. 11368, Aug. 10, 1902, Port Renfrew, B. C. (Banks Collection, Museum of Comparative Zoology, Cambridge, Mass.).

Leuctra biloba Claassen.

(Plate 40, figs. 9, 10; plate 42, fig. 6.)

1923. *Leuctra biloba* Claassen, Can. Ent., 55:258.

Length to tip of wings, male, 7 mm.; female, 8.5 mm. Expanse, male, 12 mm.; female, 14.5 mm.

General color blackish brown; head wider than prothorax, blackish, closely covered with fine pile; hind ocelli between two and three diameters distant from eyes. Prothorax dark brown, a little narrowed behind (in female not narrowed behind), wider than long; front angles broadly rounded, hind angles rather sharp; median longitudinal field at least one-fifth the width of pronotum; disc only slightly rugose. Legs brown. Wings dusky fumose; 2-4 Cu crossveins beyond M-Cu crossveins.

Male. From the anterior margin of the eighth tergite there projects backward a raised bilobed chitinous process, the lobes of which are truncate; from the tenth tergite projecting forward a bilobed chitinous process whose lobes are evenly rounded; supra-anal lobe broadly rounded; cerci unmodified; subanal lobes broadly elongate; titillators slender, a little shorter than subanal lobes; ninth sternite somewhat produced, not heavily chitinized; ventral lobe half again as long as wide, bearing long hairs.

Female. Eighth abdominal sternite produced into a bilobed subgenital plate with a shallow triangular median notch.

Holotype, male, allotype, female, May 20-25, 1911, Black Rock Mt., Rabun Co., Ga. (CornellUniversity) ; one male, same locality as type.

Leuctra bradleyi Claassen.

(Plate 41, figs. 12-15; plate 32, fig. 1.)

1923. *Leuctra bradleyi* Claassen, Can. Ent., 55:257.

Length to tip of wings, male, 6 mm. Expanse, male, 10.5 mm.

General color brown. Head brown, wider than prothorax, feebly pilose; hind ocelli about two diameters distant from eyes. Prothorax hardly wider than long,

brown, front angles quite broadly rounded, hind angles sharp; slightly narrowed behind; median longitudinal field one-fourth the width of pronotum; disc somewhat rugose. Legs brown. Wings reddish fumose; two Cu crossveins beyond M-Cu crossveins.

Male. Abdominal tergites unmodified except 10, which is partly cleft, each side being triangularly produced posteriorly; supra-anal lobe triangular, bearing at the tip a slender recurved whiplike process; cerci modified into chitinous armed processes, bulbous at the base and bearing at the tip as well as below a sharp tooth; subanal lobes greatly modified into a probe, each lobe receding into segment nine where the two lobes unite into a long, slender, posteriorly produced, upcurved probe bearing at the tip a bulbous membranous enlargement; titillators absent; ninth sternite produced into a subgenital plate which is medially deeply and broadly notched; ventral lobe large, hairy, and half again as long as wide.

Female. Unknown.

Holotype, male, July 4, 1908, Emerald Lake, Canadian Rockies (J. C. Bradley, in Cornell University Collection).

Leuctra carolinensis Claassen.

(Plate 41, figs. 1-3; plate 42, fig. 10; plate 32, fig. 4.)

1923. *Leuctra carolinensis* Claassen, Can. Ent., 55:258.

Length to tip of wings, male, 8.5 mm.; female, 9 mm. Expanse, male, 15 mm.; female, 15.5 mm.

General color dark brown or blackish. Head blackish, wider than prothorax; hind ocelli about two diameters distant from the eyes. Prothorax dark brown, the rugosities blackish, wider than long, not narrowed behind; front angles rounded, hind angles sharp; median longitudinal field between one-fourth and one-fifth the width of pronotum; disc quite rugose. Legs brown. Wings dark fumose.

Male. Seventh abdominal tergite bearing a broad, triangular, spatulate, raised, chitinous process reaching entirely across the seventh tergite; supra-anal lobe triangular, short, hairy; cerci unmodified; subanal lobes quite broad; titillators about as long as subanal lobes, broad at base but beyond very slender and curved; ninth sternite slightly produced backward; ventral lobe small, wider than long, hairy.

Female. Eighth abdominal sternite produced into a bilobed, widely emarginate subgenital plate, reaching at

least half way across the ninth sternite; the lobes of the plate bear long hairs.

Holotype, male, allotype, female, June, 1922, Black Mts., N. C. (Beutenmüller, in Cornell University Collection); other males and females from same locality as the type; one male and one female, May 21, 1911, Barton, Ga. (J. C. Bradley).

Leuctra decepta Claassen.

(Plate 40, figs. 5, 6; plate 42, fig. 4.)

1923. *Leuctra decepta* Claassen, Can. Ent., 55:260.

Length to tip of wings, male, 7 mm.; female, 8.5 mm. Expanse, male, 11 mm.; female, 14 mm.

General color brown to blackish. Head wider than prothorax, blackish; occiput finely granulate; hind ocelli between three and four diameters distant from eyes. Prothorax brown, wider than long; front angles broadly rounded, hind angles rather sharp; median longitudinal field a little less than one-fourth the width of pronotum; lateral pronotal disc quite rugose. Legs brown, wings dusky.

Male. Eighth abdominal tergite with a narrow anterior chitinized collar medially produced into a short rounded knob which is not raised or very slightly so; anterior margin of seventh tergite sometimes with a suggestion of a smaller but similar chitinized area as eighth; supra-anal lobe broadly rounded; cerci unmodified; subanal lobes quite slender and considerably longer than the titillators; ventral lobe a little longer than wide.

Female. Eighth abdominal sternite produced into a broadly and deeply notched bilobed subgenital plate, bearing long hairs and reaching nearly half way across the ninth sternite.

There seems to be considerable variation in the extent to which the chitinizations on the abdominal tergites of the males have developed in this species.

Holotype, male, allotype, female, June 29, 1922, Ringwood Hollow, Ithaca, N. Y. (Cornell University Collection); two males, five females, same locality as types; one male June 7, 1905, Old Forge, N. Y.

Leuctra duplicata Claassen.

(Plate 41, figs. 4, 5; plate 42, fig. 9.)

1923. *Leuctra duplicata* Claassen, Can. Ent., 55:260.

Length to tip of wings, male, 7 mm.; female, 8-8.5 mm. Expanse, male, 12 mm.; female, 14.5 mm.

General color blackish brown. Head wider than prothorax, blackish, covered with pile; occiput somewhat ru-

gose; hind ocelli between two and three diameters distant from eyes. Prothorax dark brown, wider than long; median longitudinal field about one-fourth the width of pronotum; disc somewhat rugose. Legs blackish brown. Wings blackish, infuscated.

Male. Seventh and eighth abdominal tergites each with a narrow chitinous collar on the anterior margin, each of these collars bearing two short triangular chitinous processes; supra-anal lobe somewhat triangular; cerci unmodified; subanal lobes broad, angulately upcurved; titillators slender, as long as subanal lobes; ventral lobe longer than wide, bearing long hair.

Female. Eighth abdominal sternite produced into a bilobed subgenital plate, notched in the middle, the lobes rounded, and before the notch a rounded raised tubercle.

Holotype, male, allotype, female, June 25, 1922, Labrador Lake, N. Y. (C. R. Crosby, in Cornell University Collection); two males, five females, June 25, 1922, Labrador Lake (C. R. Crosby); one male, one female, July 11, 1905, Brookline, Mass. (C. W. Johnson); one male, June 12-22, 1901, Adrin Mts., Axton, N. Y. (A. D. MacGillivray and C. O. Houghton); one male, June 8-10, 1915, Chipmunk Swamp, Vandolia, N. Y.; one male, June 11, 1909, Woolworth Lake, Fulton Co., N. Y.; two females, May 27, 1919, Ringwood Hollow, Ithaca, N. Y.; June 29, 1923, Adirondack Lodge, N. Y.

Leuctra glabra Claassen.

(Plate 41, figs. 9-11.)

1923. *Leuctra glabra* Claassen, Can. Ent., 55:261.

Length to tip of wings, male, 6 mm. Expanse, male, 10.5 mm.

General color reddish brown. Head brown, wider than prothorax, covered with rather long pile; hind ocelli at least twice as close to eyes as to each other. Prothorax not narrowed behind, wider than long; front angles very broadly rounded, hind angles sharp; median longitudinal field about one-fourth the width of pronotum; disc of pronotum slightly rugose. Legs brown. Wings rusty fumose; two to three Cu crossveins beyond M-Cu crossveins.

Male. Tergites of abdomen unmodified except nine in which the chitinized portion is reduced to a narrow transverse band; supra-anal lobe triangular; cerci unmodified; subanal lobes modified into long slender upcurved proceses; titillators absent; ninth sternite not much produced posteriorly; ventral lobes absent.

Female. Unknown.

Holotype, male, Nov. 15, 1899, Tamalpais, Calif. (L. O. Howard, in the U. S. National Museum).

Leuctra grandis Banks.

(Plate 40, figs. 11, 12; plate 42, fig. 7.)

1906. *Leuctra grandis* Banks, Can. Ent., 338.
1907. *Leuctra grandis* Banks, Cat., 15.
1908. *Leuctra grandis* Banks, Proc. Ent. Soc. Wash., 9:151.

Length to tip of wings, male, 9 mm.; female, 11.5 mm. Expanse, male, 17 mm.; female, 22 mm.

General color reddish brown. Head wider than prothorax; surface nearly smooth; occiput slightly rugose; hind ocelli about two and one-half diameters distant from eyes. Prothorax brown, somewhat widened behind; little wider than long; median longitudinal field at least one-fifth the width of pronotum; disc of pronotum slightly rugose. Legs brown. Wings reddish fumose; 4-5 Cu crossveins beyond the last M-Cu crossveins.

Male. Eighth tergite with a broad median chitinized plate which is apically raised and triangularly bifurcate; supra-anal lobe broadly triangular; subanal lobes long, slender; titillators considerably shorter than subanal lobes; cerci membranous, slender, about three times as long as wide; ventral lobe about twice as long as wide, very hairy.

Female. Subgenital plate produced over about half of the ninth sternite, with a deep round median notch; the outer lobes of the subgenital plate dark.

Type, female, 11369, Black Mts., N. C., June (Banks Collection, Museum of Comparative Zoology, Cambridge, Mass.); May to June, Black Mts., N. C.

Leuctra hamula Claassen.

(Plate 40, figs. 1, 2; plate 42, fig. 2.)

1923. *Leuctra hamula* Claassen, Can. Ent., 55:261.

Length to tip of wings, male, 7.5 mm.; female, 9 mm. Expanse, male, 14 mm.; female, 15 mm.

General color brown to dark brown. Head wider than prothorax, dark brown or blackish; hind ocelli about two diameters distant from the eyes. Prothorax dark brown, wider than long, narrowed behind; front angles rounded, hind angles sharp; median longitudinal field about one-fourth the width of pronotum; disc of pronotum quite rugose. Legs dark brown, wings lightly fumose.

Male. Seventh abdominal tergite bearing a moderate short, raised, spatulate process which does not extend to

the middle of the seventh tergite; supra-anal lobe rounded behind; cerci unmodified; subanal lobes quite broad; titillators about as long as subanal lobes, at the tip sharply recurved; ventral lobe about as wide as long.

Female. Eighth abdominal sternite produced into a bilobed, widely notched, subgenital plate which reaches half across the ninth sternite; the lobes are truncate and bear long hairs; median field of seventh and eighth sternite blackish.

Holotype, male, allotype, female, July, 1905, Old Forge, N. Y. (Cornell University); five males, two females, June 24, 1905, Old Forge, N. Y.; one male, one female, June 23, 1910, Woolworth Lake, Fulton Co., N. Y.; one male Sacandaga Park, N. Y. (E. P. Felt); one male, one female, Aug. 16, Mt. Marcy, Keene Valley, N. Y.; one male, six females, Aug. 1912, Mt. Katahdin, Me.

Leuctra infuscata Claassen.

(Plate 43, figs. 3-5.)

1923. *Leuctra infuscata* Claassen, Can. Ent., 55:262.

Length to tip of wings, male, 7 mm.; female, 9 mm. Expanse, male, 11 mm.; female, 15 mm.

General color dark brown. Head wider than prothorax, nearly smooth; hind ocelli about twice as close to eyes as to each other. Prothorax dark brown, narrowed behind, wider than long, median longitudinal field between one-third and one-fourth as wide as whole pronotum; disc of pronotum somewhat rugose, the rugosities blackish. Legs dark brown. Wings infuscated; Sc2 bends down to R, not at a sharp angle, but more or less with a gradual curve; 2-3 Cu crossveins beyond M-Cu crossveins.

Male. Tergites of abdominal segments unmodified; supra-anal lobe produced into a short bulbous process which is excavated above and on the lateral upper margins with a narrow chitinous band closely beset with long hairs; cerci membranous, very large, about four times as long as wide; subanal lobes produced into long swordlike processes, abruptly drawn to a slender rod before the tip and bearing below near the tip a recurved spine; titillators curved down and then up again, slender, heavily chitinized; ventral lobe very short, hairy, much wider than long.

Female. Eighth abdominal sternite produced into a subgenital plate, which is medially somewhat raised into a hairy ridge, notched in middle, the notch produced by a triangular heavily chitinized plate on each side.

Holotype, male, March, 15, 1898, Seattle, Wash. (Cornell University).

Allotype, female, April 28, 1898, Seattle, Wash.

One female, April, 14, 1899, Seattle, Wash.; three females, June 6, 1920, Shasta Springs, Calif. (C. L. Fox); one female, June 10, 1921, Yosemite Valley, Calif. (E. C. VanDyke).

Leuctra occidentalis Banks.

(Plate 41, figs. 6-8; plate 42, fig. 12.)

1907. *Leuctra occidentalis* Banks, Can. Ent., 39:329-330.

Length to tip of wings, male, 6.5-8 mm.; female, 7-8.5 mm. Expanse, male, 11-13.5 mm.; female, 12-15 mm.

General color dark brown or black. Head wider than prothorax, blackish; occiput somewhat rugose; covered with fine pile; hind ocelli about three times as close to eyes as to each other. Prothorax not narrowed behind, hardly wider than long; angles rounded; median field not over a sixth the width of pronotum; disc of pronotum quite rugose. Legs brown. Wings rusty fumose; one or two Cu crossveins beyond M-Cu crossveins.

Male. Tergites of abdominal segments unmodified except ten which is partly cleft and posteriorly produced on each side into two short triangular processes; supra-anal lobe normally recurved under the tenth tergite, but when drawn out it is produced into a triangular process with a long median upcurved prolongation; cerci modified into chitinous processes with a large terminal and a ventral tooth and about half way between these teeth often another small tooth; subanal lobes modified into a long probe with the bases drawn back underneath the subgenital plate where they unite into a long upcurved probe; ninth sternite produced into a short, truncate subgenital plate; ventral lobe short, rounded, as wide as long.

Female. Eighth abdominal sternite produced into a broadly emarginate subgenital plate, beset with long hairs, and covering most of the ninth sternite which is heavily chitinized.

Distribution.—Type, female, 11370, Laggan, Alberta, July 23, 1901 (Banks Collection, Museum of Comparative Zoology, Cambridge, Mass.); four males, four females, Boulder, Colo. (G. S. Dodds); two females, Reno, Nev., 1878 (Morrison); one male, Olympia, Wash., June 2, 1895; one male, Palo Alto, Calif., March 26, 1895; one male, Lake Tahoe, Calif. (H. C. Hubbard); one female, Olympia, Wash., May 27, 1895; two females, Olympia, Wash., June

25, 1897; one female, Three Bros. Mts., Olympic Range, Wash., Aug. 15, 1908 (J. C. Bradley).

Leuctra sibleyi Claassen.

(Plate 40, figs. 15, 16; plate 42, fig. 11.)

1923. *Leuctra sibleyi* Claassen, Can. Ent., 55:262.

Length to tip of wings, male, 8.5-9.5 mm.; female, 9.5-11 mm. Expanse, male, 14.5-15.5 mm.; female, 16-20 mm.

General color brown. Head wider than prothorax; occiput somewhat rugose and mottled with darker brown; hind ocelli between two and three diameters distant from eyes. Prothorax wider than long, brown; angles broadly rounded; median longitudinal field at least one-fifth the width of pronotum; disc of pronotum quite rugose, the rugosities darker. Legs brown. Wings subhyaline to brownish infuscated.

Male. Anterior margin of eighth tergite heavily chitinized and bearing two, long, slender, widely separated raised, chitinous processes which reach over the entire eighth tergite; supra-anal lobe rounded behind; cerci unmodified; subanal lobes quite long and slender; titillators slender, nearly straight; shorter than subanal lobes; ventral lobe at least twice as long as wide.

Female. Eighth abdominal sternite somewhat produced into a bilobed hairy subgenital plate with a small median notch.

Holotype, male, allotype, female, May 16, 1922, Moore's Brook, Ithaca, N. Y. (C. K. Sibley, in Cornell University Collection), five males, ten females, May 16, 1922; three males, one female, May 15, 1915, Taughanic, Ithaca, N. Y.

Leuctra tenuis Pictet.

(Plate 40, figs. 7, 8; plate 42, fig. 5.)

1842. *Nemoura tenuis* Pictet, Ins. Neur., 375.
1861. *Leuctra tenuis* Hag., Syn. Neur. N. A., 37.
1892. *Leuctra tenuis* Banks, Cat. Neurop. p 343.
1904. *Leuctra tenuis* Banks, Proc. Ent. Soc. Wash., 6:206.
1907. *Leuctra tenuis* Banks, Cat., 15.
1901. *Leuctra tenella* Needham, Bull. N. Y. State Mus. 47:416.

Length to tip of wings, male, 6.5-7 mm.; female, 8 mm. Expanse, male, 11-12 mm.; female, 13 mm.

General color brown to blackish brown. Head wider than prothorax, pilose; hind ocelli between two and three diameters distant from eyes. Prothorax quadrangular, a little wider than long; angles rounded; median longitu-

dinal field about one-fourth the width of pronotum; sides of disc somewhat rugose. Legs brown. Wings subhyaline; two or three Cu crossveins beyond M-Cu crossveins.

Male. Seventh abdominal tergite with an elongate raised, chitinous process, truncate at the tip, and reaching well over the eighth tergite, which is membranous and without any chitinous processes; supra-anal lobe small, rounded; cerci slender, unmodified, bearing long hairs; subanal lobes quite slender; titillators slender, considerably shorter than the subanal lobes; ventral lobe a little longer than wide.

Female. Eighth abdominal sternite somewhat produced into a truncate subgenital plate, broadly emarginate in the middle, the truncate lobes bearing long hairs.

Distribution.—Two males, Ohio Pyle, Pa., Aug. 2, 1915; one male, Wilmington, Essex Co., N. Y.; two males, Saranac Inn, N. Y., July 15, 1906; two males, three females, West Falls, N. Y.

Leuctra triloba Claassen.

(Plate 40, figs 13, 14; plate 42, fig. 8.)

1923. *Leuctra triloba* Claassen, Can. Ent., 55:263.

Length to tip of wings, male, 6.5 mm.; female, 8 mm. Expanse, male, 11 mm.; female, 14 mm.

General color dark brown. Head wider than prothorax, brown; hind ocelli between two and three diameters distant from eyes. Prothorax brown, considerably wider than long; front angles somewhat rounded, hind angles sharp; median longitudinal field at least one-fourth the width of pronotum; lateral discs somewhat rugose. Legs brown. Wings uniformly reddish fumose.

Male. Seventh abdominal tergite with a large, raised, more or less trilobed, chitinous process which reaches well onto the eighth unarmed tergite; supra-anal lobe short, rounded; cerci small, unmodified; subanal lobes quite broad and apically very finely spinulate; titillators, slender and shorter than subanal lobes; ninth sternite medially membranous and produced into a membranous lobe; ventral lobe about as broad as long.

Female. Eighth abdominal sternite produced into a bilobed, truncate, hairy subgenital plate which is rather narrowly notched in the middle.

Holotype, male, allotype, female, Sept. 14, 1899, McLean, N. Y. (Jensen, in Cornell University Collection); paratypes: one male, Oct., McLean, N. Y.; one male, Sept.

14, 1898, Ithaca, N. Y.; Oct. 16, 1923, Montreat, N. C. (C. R. Crosby and S. C. Bishop).

Leuctra truncata Claassen.

(Plate 40, figs. 3, 4; plate 42, fig. 3.)

1923. *Leuctra truncata* Claassen, Can. Ent., 55:263.

Length to tip of wings, male, 7 mm.; female, 8.9 mm. Expanse, male, 12.5 mm.; female, 15-17 mm.

General color brown. Head wider than prothorax, uniformly brown, occiput slightly rugose; hind ocelli between two and three diameters distant from eyes. Prothorax brown, a little wider than long, slightly narrowed behind; median longitudinal field about one-fourth the width of entire pronotum; sides of disc moderately rugose. Legs brown, wings subhyaline.

Male. Seventh abdominal tergite smooth; eighth tergite bearing near the anterior margin a short median, truncate, chitinous projection, about as wide as long; supra-anal lobe short, triangular; cerci unmodified; subanal lobes quite slender; titillators considerably shorter than subanal lobes; ventral lobe very little longer than wide.

Female. Eighth abdominal sternite slightly produced into a broadly notched bilobed subgenital plate, the lobes rounded and bearing long hairs.

Holotype, male, allotype, female, Aug. 9, 1905, Old Forge, N. Y. (Cornell University Collection); also many males and females from same locality as type.

Genus PERLOMYIA Banks.

1906. *Perlomyia* Banks, Can. Ent., 38:338.
1907. *Perlomyia* Banks, Cat. Neurop., p. 14.
1909. *Perlomyia* Enderlein, Zool. Anz., 34:394.

Very closely allied to Leuctra. Small blackish forms not over 15 mm. in length.

Head wider than prothorax, blackish, with three ocelli; hind ocelli closer to eyes than to each other; just back of hind ocelli a transverse depression; surface of head covered with fine pile; antennae brown or blackish; maxillary palpi large.

Prothorax distinctly longer than wide; front angles and margin rounded; surface only moderately rugose. Legs brown or blackish; middle tarsal segment short, first and third tarsal segments subequal in the prothoracic legs; in meso- and metathoracic legs the first tarsal segment is longer than the third. Wings subhyaline or

lightly infuscated; in both front and hind wings radial sector and media arise from arculus; venation as in figure 5, plate 32.

Abdomen brown; cerci composed of single segments.

Male. Supra-anal plate short, upcurved; subgenital plate moderately long; ventral lobe present.

Female. Eighth abdominal sternite not prolonged into a distinct subgenital plate.

Genotype, *Perlomyia collaris* Bks.

Perlomyia collaris Banks.

(Plate 43, fig. 6.)

1906. *Perlomyia collaris* Banks, Can. Ent., 38:338.

1907. *Perlomyia collaris* Banks, Cat. Neurop., p. 14.

Length to tip of wings, ♀ 13 mm. Expanse, 22 mm.

General color black.

Head black, covered with white pile; a rather deep transverse depressed area just behind the posterior ocelli; ocellar triangle wider than long; hind ocelli about twice as close to eyes as to each other. Antennae blackish brown.

Prothorax black, longer than wide; surface lightly rugose; front and hind margins rounded; sides somewhat convex; front angles broadly rounded, entire pronotum covered with white pile. Legs blackish, somewhat lighter inside. Wings subhyaline with a reddish hue. Except for the fact that Rs and M of forewing both arise from the arculus the venation is like that of Leuctra. In the hind wings of the type there are two or three cubital crossveins.

Abdomen blackish with a lighter dorsal longitudinal stripe; ventral surface of abdomen brown.

Male. Unknown.

Female. Posterior margin of the eighth abdominal sternite slightly emarginate in the middle and not produced into a subgenital plate (type rather badly shriveled).

This species was described by Banks from a single ♀ from Wellington, B. C. (Taylor).

Type, female, 11367 (Banks Collection, Museum Comparative Zoology, Cambridge, Mass.); from Wellington, B. C.

Perlomyia utahensis, new species.

(Plate 32, fig. 5; plate 43, figs. 1, 2.)

Length to tip of wings, male, 11 mm. Expanse, 19 mm.

General color dark brown.

Head blackish, little wider than prothorax, covered

with white pile; a transverse depressed area just back of hind ocelli; the hind ocelli about three times as close to the eyes as to each other; antennae brown; maxillary palpi very large.

Prothorax blackish brown, distinctly longer than wide; slightly narrowed behind; front margin rounded; sides straight, surface rugose, the rugosity black. Legs brown. Middle tarsal segment short; first tarsal segment of meso and metathoracic segments longer than third. Wings uniformly subhyaline, with a reddish or rusty tinge; veins brown.

Abdomen brown.

Male. Cerci chitinized with a small black spur at the tip and a large black tooth at the base pointing upward; supra-anal plate bifid at the base and ending in a sharply pointed upturned process with a knob on the lower hind margin; subanal lobes modified into enlarged membranous processes which bear above at the base a short chitinized tooth; subgenital plate reaching about to the tip of the cerci; ventral lobe broadly rounded, about twice as long as wide.

Female. Unknown.

Holotype, male, Logan, Utah (A. O. Larsen, in Cornell University Collection). In general this species is very similar to *P. collaris* Bks. and may prove to be the same. Until bred specimens are available it may better be considered as a distinct form.

Genus TAENIOPTERYX Pictet.

1842. *Taeniopteryx* Pictet, Ins. Neur., p. 345.
1861. *Taeniopteryx* Hagen, Syn. Neur. N. A., p. 34.
1894. *Taeniopteryx* Morton, Trans. Ent. Soc. London, p. 559.
1902. *Taeniopteryx* Klapalek, Termes. Fuzetek, 25:178.
1907. *Taeniopteryx* Banks, Cat. Neur. Ins., p. 14.
1909. *Taeniopteryx* Klapalek, Suesswasserf. Deutschl., 8:57.

Dark brown or blackish species, mostly under 15 mm. in length with very long antennae; tarsal segments subequal; cerci very short.

Head not much wider than prothorax; a depressed area between the hind ocelli; lateral tubercles large, flat, polished; occiput usually with broken longitudinal dark lines; hind ocelli at least twice as close to eyes as to each other. Antennae composed of about fifty or more segments.

Prothorax wider than long, usually widened behind; sides mostly convex; surface slightly to moderately rugose. Legs dark; tarsal segments subequal. Wings hya-

line to infuscated; radial sector with two or three branches; forewing with 5-12 cubital crossveins, and with the second anal vein forked; anal field of hind wings large.

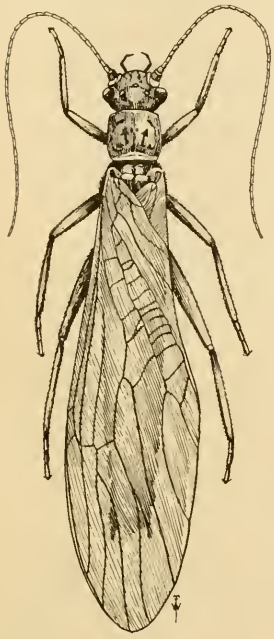

Fig. 27. *Taeniopteryx nivalis* Fitch.

Abdomen cylindric, dark brown or blackish; cerci in males with one to six segments, in females with five or six segments.

Male. Supra-anal lobe short, upturned in the form of a probe; subanal lobes mostly modified into accessory copulatory organs; ninth abdominal sternite usually prolonged into a subgenital plate which often bears at the base a small ventral appendage.

Female. Eighth abdominal sternite unmodified; genital opening mostly near the middle of the eighth sternite; ninth sternite slightly produced in some species while in others it is prolonged greatly into a ventral plate which reaches to the tip of the abdomen or even beyond.

Genotype, *Taeniopteryx trifasciata* Pict. (European).

Key to the Species of Taeniopteryx.

Males.

1. Two ocelli, wings spotted, subgenital plate keel-shaped (subgenus *Doddsia* subg. nov.) _____ *occidentalis*

   Three ocelli, wings clear or infuscated but not banded; subgenital plate flattened or rounded below _____ 2

2. Cerci composed of a single segment; subgenital plate moderately long; supra-anal lobe short, bluntly pointed, sub-anal lobes symmetrical, no costal crossvein immediately beyond the cord (subgenus *Nepheloptery.x* Klap.) _____ 3

   Cerci composed of four to six segments; subgenital plate greatly prolonged; supra-anal lobe variously modified; subanal lobes asymmetrical; a slanting costal crossvein just beyond the cord _ 5

3. Subgenital plate without a ventral appendage ---------- *parvula*
   Subgenital plate with a ventral appendage ---- 4
4. Hind femora armed with a strong tooth---*maura*
   Hind femora unarmed ---------- *nivalis*
5. Hind margin of subgenital plate with a flattened narrow prolongation turned up at a right angle; ninth abdominal tergite bears two rearward pointing lobes (subgenus *Rhabdiopteryx* Klap.) ---------- *fasciata*
   Hind margin of subgenital plate rounded or truncate, without lobes or appendages (though similar lobes are often present on the tenth tergite) 6
6. No crossveins beyond the end of subcosta; subgenital plate with a ventral appendage---------- *contorta*
   A slanting crossvein just beyond the tip of subcosta; subgenital plate without a ventral appendage (subgenus *Taeniocnema* Bks.) -------- 7
7. Tenth abdominal tergite without two raised, rearward pointing appendages; lobes at base of cerci in the form of sharp spine-like processes directed backward ---------- 8
   Tenth abdominal tergite with two raised rearward pointing appendages; lobes at base of cerci not sharply pointed ---------- 9
8. Wings usually heavily infuscated, yellowish at the base; supra-anal lobe gradually tapering to a point, length, 9-10 mm.----------*nigripennis*
   Wings lightly infuscated, with a clear band across the wing between the cord and tip; supra-anal lobe enlarged towards the tip where it is broadly rounded; lobes at base of cerci very slender, length, 12 mm. ----------*grinnelli*
9. Supra-anal lobe, viewed from above, deeply emarginate behind ----------*oregonensis*
   Supra-anal lobe viewed from above not emarginate behind ---------- 10
10. Supra-anal process broadly bifurcate (side view) with a short tooth near the base of the bifurcation; lobes at base of cerci finely granulate---- ---------- *californica*
    Supra-anal process not bifurcate at tip; lobes at base of cerci very coarsely granulate---*pacifica*

Females.

1. Hind margin of ninth abdominal sternite produced into narrow or broad yellow plate-like appendage ---------- 2
   Hind margin of ninth abdominal sternite little, if at all, produced—never in the form of a plate-like appendage ---------- *T.* (*Nephelopteryx*) *maura, parvula, nivalis*
2. Ninth abdominal sternite with a narrow, triangular tongue-like appendage ---------- *T.* (*Rhabdiopteryx*) *fasciata*
   Ninth abdominal sternite with a broadly rounded plate-like appendage ---------- 3
3. Wings spotted, hind margin of eighth abdominal sternite partly cleft---- *T.* (*Doddsia*) *occidentalis*
   Wings not spotted, hind margin of eighth abdominal sternite straight *T.* (*Taeniopteryx*) *pacifica, nigripennis, pallida, banksei, californica*

Taeniopteryx maura Pictet.

(Plate 33, fig. 4; plate 44, figs. 5, 6; plate 46, fig. 7.)

1842. *Nemoura maura* Pictet, Ins. Neur., p. 361.
1861. *Taeniopteryx maura* Hagen, Syn. Neur. N. A., p. 35.
1892. *Taeniopteryx maura* Banks, Cat., p. 342.
1904. *Taeniopteryx maura* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Taeniopteryx maura* Banks, Cat. Neur., p. 14.

Length to tip of wings, male, 8-10 mm.; female, 11-12 mm. Expanse, male, 14-17 mm.; female, 20-22 mm.

General color brown to blackish.

Head slightly wider than prothorax, brown; a depressed area between the hind ocelli; occiput quite rugulose; hind ocelli only about two diameters distant from the eyes; antennae brown, composed of about 58-60 segments.

Prothorax brown, lighter on the lateral margins, and often a light median longitudinal line so that the pronotum appears light brown with two longitudinal dark lines; wider than long, a little widened behind; angles narrowly rounded; surface quite smooth. Legs brown; the hind femora of the male with a stout downward pointing tooth on the underside near the middle; wings hyaline, or slightly infuscated; subcosta has a tendency to run into costa near the tip before it turns down to radius; subcosta does not reach to the cord; ordinarily no costal crossveins either before or beyond the tip of Sc; usually not more than 7 or 8 cubital crossveins in the forewing.

Abdomen brown, often a median light longitudinal line,

more or less interrupted. Cerci of male composed of one segment, in the female of six or seven segments.

Male. Very similar to *T. nivalis* Fitch. Supra-anal process short, upturned, largely membranous, finely roughened or spinulose at tip; at least twice as wide at base as near the tip; subanal lobes large, triangular, unevenly chitinized; cerci composed of a single globose segment, more heavily chitinized above, hairy and at the tip somewhat emarginate; ninth abdominal sternite produced into an evenly rounded subgenital plate which bears near the center a ventral lobe or appendage.

Female. Genital opening near the middle of the eighth abdominal sternite, not covered by a subgenital plate; hind margin of ninth sternite somewhat produced and evenly rounded.

Distribution.—Washington, D. C., March 2, March 5, March 11-12 (H. S. Barber); Plummers Is., Md., Feb. 22, 1922 (H. S. Barber); Plummers Is., Md., Feb. 24, 1903 (R. P. Currie); Rosslyn, Va., March 23, 1902 (H. S. Barber); Gloversville, N. Y., March 28, 1907 (C. P. Alexander); Harmony, Col. Co., Nova Scotia, March 20, 1924 (W. H. Brittain).

Taeniopteryx nivalis Fitch.

(Plate 33, fig. 1; plate 44, figs. 3, 4; plate 46, fig. 8.)

1847. *Taeniopteryx nivalis* Fitch, Emmons Jour. Agr. Sci., 5:274.

Length to tip of wings, male, 11-14 mm.; female, 13-17 mm. Expanse, male, 17-23 mm.; female, 22-28 mm.

General color dark brown to blackish.

Head about as wide as prothorax, hairy; tubercles at base of antennae dark brown and somewhat triangular in shape; a dark brown or black area in front of anterior ocellus; occiput quite rugose; hind ocelli only about three diameters distant from the eyes; antennae brown, composed of about fifty-five segments.

Prothorax brown to black, the margins lighter, particularly the front margin; wider than long, widened behind; angles more or less rounded; surface nearly smooth; a few rounded raised marks near the front angles often visible; a short, narrow, transverse, depression in the center of the pronotum (more often broken by the median longitudinal line). Legs brown to blackish. Wings hyaline to infuscated, in the specimens with infuscated wings, two faint transverse lighter bands are sometimes visible in the fore wing, one band before the cord and the second beyond the cord; subcosta gradually bends upward until

it nearly touches costa at the cord where it bends down to meet radius; no costal crossveins except the short one at end of subcosta and sometimes a faint crossvein in the costal field near the tip of wings; Rs forks considerably beyond the cord; usually about ten cubital crossveins in forewing.

Abdomen brown. Cerci of male composed of a single segment, of female about eight to ten segments.

Male. Supra-anal process short, erect or slightly recurved, membranous and finely spinulose at the tip, nearly twice as wide at base as at tip; subanal lobes triangular, little modified except that they are unevenly chitinized; cerci composed of a single globose segment more heavily chitinized above, and at the tip usually somewhat emarginate; ninth abdominal sternite produced into a subgenital plate, which reaches to the tip of the abdomen and bears near the center a short ventral lobe.

Female. Genital opening near the hind margin of the eighth abdominal sternite, the opening not covered by a subgenital plate; hind margin of ninth abdominal sternite somewhat produced and evenly rounded.

Distribution.—Feb. 10-March 24, Ithaca, N. Y.; March 19, 1913, Honeoye Falls, N. Y. (C. R. Crosby); March 21, Adams Center, N. Y. (P. W. Claassen); March 14 and April 10, Albany, N. Y.; March 26, Pike, N. Y.; April 29, Binghamton, N. Y.; March 9, March 16, March 23, March 29, April 8, Harrisburg, Pa.; March 22, 1889, Philadelphia, Pa.; April 4, Athens, Pa.; March 2, Camphill, Pa.; Feb. 1, 1919, Washington, D. C. (C. D. Duncan); March 5, Washington, D. C. (H. S. Barber); Feb. 24, 1903, Plummers Id., Md. (W. V. Warner); Feb. 19, Feb. 22, Plummers Id., Md. (H. S. Barber); March 15, 1905, Raleigh, N. C. (C. S. Brimley); 1877, Morgantown, N. C. (Morrison); Waldoboro, Me. (J. H. Lovett); Orono, Me.; Westbrook, Me. (O. O. Stover); Durham, N. H. (W. & F.); Wellesley, Mass. (A. P. Morse); Springfield, Mass. (L. Stebbins); April 6, April 22, Winchendon, Mass. (F. W. Russell); New Lenox, Ill., No. 6221; Feb. 12, 1906, near Embarrass R., Coles Co., Ill.

Taeniopteryx parvula Banks.

(Plate 44, figs. 1, 2; plate 46, fig. 9.)

1918. *Taeniopteryx parvula* Banks, Bull. Mus. Comp. Zool., 62:7.

Length to tip of wings, male, 9-12 mm.; female, 10-14 mm. Expanse, male, 15-21 mm.; female, 18-24 mm.

General color brown to blackish.

Head brown to blackish, a little wider than prothorax;

a depressed area between the hind ocelli; occiput quite rugose; hind ocelli only about two diameters distant from the eyes; antennae brown, composed of about fifty to fifty-five segments.

Prothorax brown to blackish; wider than long; somewhat widened behind; angles rounded; surface nearly smooth; legs brown. Wings hyaline; subcosta approaches costal before it bends down to radius before the cord; no costal crossveins except the one at the end of subcosta (when Sc does not actually touch C) and rarely near the tip of the wing; radial sector forks a considerable distance beyond the cord; about eight or nine cubital crossveins in the forewing.

Abdomen brown. Cerci of male composed of a single globose segment, in female of six to eight segments.

Male. Supra-anal process short, upturned, largely membranous, at least twice as wide at base as near tip; subanal lobes large, triangular, partly membranous and on the posterior margin with a recurved tip; cerci composed of a single, large, subglobose segment; ninth abdominal sternite produced into an evenly rounded subgenital plate which does not bear a ventral appendage or lobe.

Female. Genital opening near the middle of the eighth abdominal sternite, not covered by a subgenital plate; hind margin of ninth abdominal sternite produced and evenly rounded.

Distribution.—Holotype, male, allotype, female, and paratypes, four males, Feb. 24, 1903, Plummers Id., Md. (Currie, Warner and Barber, in U. S. National Museum); four males, March 1, 1902, Washington, D. C. (H. S. Barber); one male, March 11, 1902, Washington, D. C. (H. S. Barber); four males, March 12, 1902, Washington, D. C. (W. V. Warner and H. S. Barber); one male, one female, March 2, 1902, Washington, D. C. (H. S. Barber); one male, March 12, Orono, Me.; one male, March 12, 1894, Black R. Falls, Wis.; one male, April 8, Hennepin Co., Minn.; one male, one female, April 20, Taunton, Mass.; one male, Riverton, N. J.

Taeniopteryx contorta new species.

(Plate 45, figs. 5, 6.)

Length to tip of wings, male, 11 mm. Expanse, male, 18.5 mm.

General color dark brown or blackish. Head a little narrower than prothorax; uniformly brown, not rugulose; lateral tubercles large and considerably raised; a de-

pressed area between the hind ocelli; hind ocelli about three times as close to eyes as to each other; antennae brown, composed of about fifty-five segments.

Prothorax brown, broader than long, slightly widened posteriorly; angles rounded; surface somewhat rugose. Legs brown. Wings subhyaline; subcosta gradually approaches costa until it bends down rather abruptly some little distance before the cord; no costal crossveins, except one at the tip of subcosta when Sc does not actually touch costa; no crossvein beyond the cord.

Abdomen brown. Cerci of male composed of four short segments.

Male. Supra-anal process consists of two short erect rounded processes one behind the other and each bilobed at the tip; subanal lobes asymmetrical and quite complicated, each lobe has a triangular inward pointing chitinized sheath above, and underneath these processes are seen the lower portions of the lobes as shown in plate 45, figures 5 and 6; a large raised granular process or lobe at the base of each cercus; ninth abdominal sternite greatly prolonged into a subgenital plate which reaches far beyond the tip of segment ten; near the base of the subgenital plate is a broadly rounded ventral appendage or lobe.

Female, unknown.

Holotype, male, March 18, Jaffrey, N. H. (C. W. Johnson, Cornell University Collection).

Taeniopteryx fasciata Burmeister.

(Plate 33, fig. 2; plate 45, figs. 3, 4; plate 46, fig. 2.)

1839. *Semblis fasciata* Burmeister, Handb. Ent., 2:875.
1842. *Nemoura fasciata* Pictet, Ins. Neurop., 359.
1852. *Nemoura fasciata* Walker, Cat., p. 179.
1861. *Taeniopteryx fasciata* Hagen, Syn. Neur. N. A., p. 34.
1892. *Taeniopteryx fasciata* Banks, Cat., p. 342.
1904. *Taeniopteryx fasciata* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Rhabdiopteryx fasciata* Banks, Cat. Neurop. Ins., p. 14.
1861. *Taeniopteryx frigida* Hagen, Syn. Neur. N. A., p. 35.
1892. *Taeniopteryx frigida* Banks, Cat., p. 342.
1904. *Taeniopteryx frigida* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Taeniopteryx frigida* Banks, Cat. Neur. Ins., p. 14.
1908. *Taeniopteryx frigida* Banks, Proc. Ent. Soc. Wash., 9:150.

Length to tip of wings, male, 10-12 mm.; female, 14-15 mm. Expanse, male, 18-22 mm.; female, 26-27 mm.

General color blackish.

Head dark brown to blackish with yellow inside the eyes; a depressed area between the hind ocelli; large black flat areas just in front of anterior ocelli; occiput

with longitudinal slight rugosities; hind ocelli three to four times as close to eyes as to each other. Antennae dark brown to blackish.

Prothorax as wide or little wider than head; wider than long; widened posteriorly, angles sharp or narrowly rounded; surface slightly rugose; margins usually brown or yellowish, rest of prothorax dark brown. Legs brown; femora darker above; tibia darker at both ends; tarsi dark. Wings subhyaline; an infuscated transverse area across the cord and another at the tip of the forewings; the pterostigma also is infuscated; Sc does not reach quite to the cord; one or two costal crossveins near the tip of subcosta and one beyond; Cu1 with only one or two accessory branches.

Abdomen dark brown; cerci yellowish, short, composed of five or six short segments.

Male. Hind margin of ninth abdominal tergite with two rearward pointing, rounded hairy knobs or lobes; supra-anal process very short (hardly longer than the knobs at the base of the cerci) heavily chitinized, upturned and ending in a gradually tapering blunt point, the hind margin of the supra-anal process bears a membranous, bulbose enlargement; subanal lobes asymmetrical, largely membranous (see plate 45, figure 3a); ninth abdominal sternite greatly prolonged into a subgenital plate which reaches beyond the tip of the abdomen and medially narrows to a chitinous upturned process; ninth sternite without a ventral appendage; at the base of each cercus occurs a rounded, bulbous knob.

Female. Genital opening of eighth abdominal sternite not covered by a subgenital plate; ninth sternite with a median, yellow, triangular process which reaches nearly to the tip of the subanal lobes.

Distribution.—March 21, 1905, Raleigh, N. C. (C. S. Brimley); April 2, 1921, Melville, W. Va. (J. C. Bradley); 1877, Morgantown, N. C. (Morrison); March 23, 1902, Rosslyn, Va. (H. S. Barber); April 5, 1901, Nashville, Tenn. (E. B. Williamson); March 4-April 4, Washington, D. C. (Warner & Barber); Feb. 19-April 18, Plummers Is., Md. (Currie, Warner, Barber, Bradley); March 5-April 14, Harrisburg, Pa.; W. Springfield, Mass. (George Dimmock); March 30, 1889, Forest Hill, Mass. (S. Henshaw); March 21-April 10, Ithaca, N. Y.; April 5, 1902, Karner, N. Y.; April 22, 1902, E. Greenburgh, N. Y.; April 11, 1901, Hamburg, N. Y. (E. P. Van Duzee); Mo. (C. V. Riley); March 20-April 5, Riley Co., Kans. (F. Marlatt); April 18, 1922, Minneapolis, Minn. (William E. Hoffman).

Taeniopteryx nigripennis Banks.

(Plate 45, figs. 7, 8; plate 46, fig. 4.)

1918. *Taeniopteryx* (*Rhabdiopteryx*) *nigripennis* Banks, Bull. Mus. Comp. Zool., 62, No. 1, p. 8.

Length to tip of wings, male, 9-10 mm.; female, 11-12 mm. Expanse, male, 16-19 mm.; female, 19-21 mm.

General color blackish with infuscated wings. Head not wider than prothorax, blackish with brown inside the eyes, in the depressed area between the hind ocelli and in front of anterior ocellus; occiput somewhat rugose; hind ocelli about twice as close to eyes as to each other. Antennae blackish.

Prothorax dark brown to black, with the margins lighter in some of the specimens; wider than long; somewhat widened behind; angles rounded; surface somewhat rugose. Legs dark brown to black. Wings lightly to heavily infuscated. In the infuscated wings the base of the wings is yellow, the yellow color extending from the costal margin to cubitus and forward to the fork of Cu1 and Cu2; subcosta does not reach to the cord; one or two costal crossveins before the end of subcosta and one beyond the cord.

Abdomen dark brown, the ninth sternite of male yellow. Cerci composed of six segments.

Male. Supra-anal process short, erect, tapering to a blunt point; subanal lobes asymmetrical, divided into several membranous processes; at the base of each cercus a chitinous, raised, pointed process, curved at the tip and membranous on the underside; ninth abdominal sternite prolonged into a truncate subgenital plate which reaches beyond the tip of segment ten and bears long hair on the hind margin; no ventral appendage or lobe on the subgenital plate.

Female. Genital opening not guarded by valves or covered by a subgenital plate; ninth abdominal sternite prolonged into a broad, rounded plate which reaches nearly to the tip of the abdomen.

Type, No. 10051, Wenatchee, Wash., May 21, 1915 (Newcomer, in Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); one male, one female, May 2, 1909, Parley Canyon, Utah (E. G. Titus); two males, five females, Boulder, Colo. (G. S. Dodds).

Taeniopteryx pacifica Banks.

(Plate 33, fig. 5; plate 45, figs. 11, 12; plate 46, fig. 3.)

1900. *Taeniopteryx pacifica* Banks, Tran. Am. Ent. Soc., 26:244.
1907. *Taeniopteryx pacifica* Banks, Can. Ent., 39:329.
1907. *Taeniopteryx pacifica* Banks, Cat. Neur. Ins., p. 14.
1918. *Taeniopteryx pacifica* Newcomer, Jour. Agr. Res., Vol. 13, No. 1, 37-41.
1905. *Taenionema analis* Banks, Psyche, 12:57.
1907. *Taenionema analis* Banks, Cat. Neur. Ins., p. 14.

Length to tip of wings, male, 12-13 mm.; female, 14-15 mm. Expanse, male, 22-25 mm.; female, 25-28 mm.

General color brown to blackish with yellowish or reddish brown on head, thorax and tip of abdomen, especially in the male.

Head a little narrower than prothorax; brown with lighter areas inside the eyes, in front of anterior ocellus, and often yellowish in the depressed area between the hind ocelli; lateral tubercles large; occiput rugulose, the rugosities in the form of wide, broken longitudinal lines; hind ocelli a little more than twice as close to the eyes as to each other. Antennae brown.

Prothorax brown, with the margins yellowish and usually with some yellowish marks on the disc of the pronotum; wider than long, widened behind; sides somewhat convex; angles rounded; surface quite rugose. Legs brown. Wings hyaline, with a faint cloud or infuscated area along the cord; subcosta does not quite reach to the cord; three or four costal crossveins before the end of subcosta and one beyond.

Abdomen dark brown to blackish except in the male, where the ninth sternite is yellow. Cerci composed of six short segments.

Male. Supra-anal process short, erect with the tip directed backward and bearing behind a membranous, bulb-like attachment; subanal lobes asymmetrical, divided into several membranous processes; at the base of each cercus a large raised turberculate rounded process directed backwards; tenth abdominal tergite bears two short, rounded processes directed backwards; subgenital plate extends considerably beyond the tip of the tenth segment, and there is no ventral appendage.

Female. Genital opening of the eighth abdominal sternite not guarded by valves or covered by a subgenital plate; ninth abdominal sternite prolonged into a broad rounded plate which does not reach to the tip of the subanal lobes.

Type, No. 11304, male, Pullman, Wash. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); eight females, one male, April, Wenatchee, Wash.; one male, March 31, Ft. Collins, Colo.; four males, one female, March 30-April 4, Boulder, Colo.; April 3-7, 1897, Pullman, Wash.; June 17, 1901, Banff, Alberta.

Taeniopteryx californica, new species.

(Plate 45, figs. 9, 10; plate 46, fig. 5.)

Length to tip of wings, female, 11 mm. Expanse, female, 17.5 mm.

General color brown to blackish.

Head brown, a little wider than prothorax; occiput rugose, the rugosities and lateral tubercles darker brown; a depressed area between the hind ocelli; hind ocelli at least three times as close to the eyes as to each other; antennae brown, composed of about fifty segments.

Prothorax brown, wider than long; slightly widened behind; angles almost square; surface quite rugose. Legs brown. Wings hyaline. Subcosta reaches the cord in the hind wing; three costal crossveins before the end of subcosta and one beyond.

Abdomen brown. Cerci composed of six segments in the male and five in the female.

Male. Supra-anal process short, erect, bifurcate with the points of the two processes directed backward and with a small knob at base of the bifurcation; subanal lobes asymmetrical, largely membranous; a large raised granular knob or process at the base of each cercus; tenth abdominal tergite with two rearward pointing, rounded, chitinous lobes; ninth abdominal sternite greatly prolonged into a subgenital plate which reaches beyond the tip of segment ten; the subgenital plate does not bear a ventral lobe or appendage.

Female. Genital opening not guarded by valves or covered by a subgenital plate; ninth abdominal sternite greatly prolonged into a broadly rounded subgenital plate which reaches beyond the tips of the cerci.

Holotype, male, allotype, female, Feb. 1892, Palo Alto, Calif. (Cornell University Collection); paratype, one female, March, 1892, Palo Alto, Calif.

Taeniopteryx grinnelli Banks.

(Plate 46, fig. 6.)

1918. *Taeniopteryx grinnelli* Banks, Bull. Mus. Comp. Zool., 62:8.

Length to tip of wings, male, 12 mm. Expanse, male, 20 mm.

General color black with lightly infuscated wings.

Head blackish, not quite as wide as prothorax; a depressed area between the hind ocelli; hind ocelli more than twice as close to the eyes as to each other; antennae blackish.

Prothorax blackish brown with about fifteen to eighteen shiny flat tubercles; wider than long; sides convex; angles rounded. Legs brown, darker above; tarsi blackish. Wings lightly infuscated, especially at the tip and at the cord so as to leave a clear band between the cord and the tip; base of wing subhyaline; subcosta reaches to the cord; two or three costal crossveins before the end of subcosta and one beyond.

Abdomen blackish with a yellow tip; cerci of male composed of about six segments.

Male. Supra-anal lobe short, erect, enlarged toward the tip where it is broadly rounded; at the base of each cercus a slender curved or sigmoid pointed process directed backwards; subanal lobes asymmetrical (much shriveled up in dried specimen); ninth abdominal sternite much prolonged into a subgenital plate which reaches far past the tip of the abdomen and is closely beset with long hairs; subgenital plate without a ventral appendage.

Female, unknown. The female cotype of Banks apparently does not belong here. It is paler in color, the wings are entirely clear, the markings on head and prothorax are different and it measures only 11 mm in length.

Type, male, No. 10050, April 10, 1905, Millard Canyon, Los Angeles, Pasadena, Calif. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.).

Taeniopteryx oregonensis, new species.

(Plate 44, figs. 7, 8.)

Length to tip of wings, male, 12-13 mm. Expanse, male, 20-22 mm.

General color black with lightly infuscated wings.

Head about as wide as prothorax, blackish with yellowish inside the eyes and sometimes within the depressed area between the hind ocelli; occiput somewhat rugose; hind ocelli more than twice as close to eyes as to each other; antennae black, with about fifty segments.

Prothorax black with the lateral margins sometimes a little yellowish; wider than long; widened behind; sides somewhat convex; angles rounded; surface somewhat rugose. Legs dark brown, the femora darker above and the tarsi blackish. Wings lightly infuscated; subcosta reaches almost to the cord; two or three costal crossveins before the end of the subcosta and one beyond.

Abdomen black, yellow at the tip. Cerci of male yellow, with six segments.

Male. Supra-anal lobe short, erect, directed backward at the tip and there emarginate so as to form two rearward pointing processes; subanal lobes modified into asymmetrical complex membranous processes; at the base of each cercus a slender, bluntly pointed, tuberculate process; tenth abdominal tergite with two rearward pointing, broadly truncate lobes, similar to *T. pacifica*; ninth abdominal sternite greatly prolonged into a subgenital plate which surpasses far the tip of the abdomen; subgenital plate without a ventral appendage.

Female, unknown.

Holotype, male, and two male paratypes, Feb. 21, 1912, Corvallis, Ore. (H. F. Wilson, Cornell University Collection).

Taeniopteryx banksii, new name.

(Plate 46, fig. 10.)

1918. *Taeniopteryx pallida* Banks, Bull. Mus. Comp. Zool., 62, No. 1, p. 9 (preoc.).

Length to tip of wings, female, 12 mm. Expanse, female, 20 mm.

General color dark brown or slightly reddish.

Head dark brown with a black spot over the ocellar triangle, and with black longitudinal broken lines on the occiput; lateral tubercles flat, dark to blackish; a depressed area between the hind ocelli; hind ocelli about three times as close to eyes as to each other; antennae dark brown or blackish.

Prothorax a little narrower than head; wider than long; somewhat widened posteriorly; sides convex; angles rounded; blackish and usually with lighter margins; surface somewhat rugose. Legs reddish brown, tarsi darker. Wings uniformly hyaline; subcosta does not quite reach the cord; two or three costal crossveins before the end of subcosta and one beyond.

Abdomen blackish with a yellow tip. Cerci yellowish with about six segments.

Male, unknown.

Female. Genital opening not guarded by valves or covered by a subgenital plate; ninth abdominal sternite produced into a wide evenly rounded plate.

Type, female, No. 10052, May 31, 1915, Wenatchee, Wash. (Newcomer, in Banks Coll., Mus. Comp. Zool., Cambridge, Mass.).

This is in all probability indentical with *T. pacifica* Banks.

Taeniopteryx pallida Banks.

(Plate 46, fig. 11.)

1902. *Nemoura pallida* Banks, Can. Ent., 34:125.
1907. *Nemoura pallida* Banks, Cat. Neurop., p. 14.

Length to tip of wings, female, 12 mm. Expanse, female, 21 mm.

General color rusty brown, including the wings which are infuscated with a reddish brown.

Head reddish brown, not wider than prothorax; a depressed area between the hind ocelli; occiput with fine longitudinal broken lines; hind ocelli about twice as close to eyes as to each other; antennae dark brown.

Prothorax reddish brown; wider than long; widened behind; angles rounded; sides convex; surface very slightly rugose. Legs brown. Wings uniformly reddish; veins reddish brown; subcosta does not reach the cord; about three costal crossveins before the end of subcosta and one beyond.

Abdomen dark brown. Cerci composed of five segments.

Male, unknown.

Female. Genital opening of eighth abdominal sternite not guarded by valves or covered by a subgenital plate; ninth sternite produced into a wide evenly rounded plate.

Type, female, No. 11362, July 18, 1898, Little Beaver, Colo. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.).

Taeniopteryx occidentalis Banks.

(Plate 33, fig. 3; plate 45, figs. 1, 2; plate 46, fig. 1.)

1900. *Taeniopteryx occidentalis* Banks, Trans. Am. Ent. Soc., 24:244.

Length to tip of wings, male, 11 mm.; female, 12-15 mm. Expanse, male, 18 mm.; female, 20-25 mm.

General color blackish with spotted wings.

Head about as wide as prothorax; black with brown beside the eyes, on the clypeus, and from each side of the ocellar triangle a narrow brown mark towards the base of the antennae; a depressed area between the hind ocelli and in this depression usually a small brownish spot;

lateral tubercles large, flat, polished; occiput not rugulose; surface covered with yellowish pile; with only two ocelli, (in the single male specimen the anterior ocellus is faintly indicated by a mere dot under the chitin, but in the eighteen females there is no indication of an anterior ocellus), ocelli at least twice as close to eyes as to each other; antennae dark brown with about fifty segments.

Prothorax black, with a yellow or reddish front margin and often a little yellowish at the sides and behind; a little wider than long; not widened behind; the sides somewhat convex; angles rounded; surface finely rugulose. Legs yellowish brown with variegated dark markings. Wings spotted with fuscous as in the figure; veins heavy, dark brown.

Abdomen dark brown, yellow at the tip (ventral view). Cerci composed of four segments in the male and five in the female.

Male. Supra-anal process short, erect, enlarged toward the tip where the process is broadly bilobed or bifurcate; anteriorly the supra-anal process bears a bilobed tubercle, posterior to the supra-anal process is a large, spinulose, bulbose membrane; subanal lobes greatly modified into asymmetrical processes; just back of each cercus occurs a black, chitinous, inward curved process, below these processes the asymmetrical membranous parts of the subanal lobe and below these two upcurved pointed chitinous processes closely beset with long hairs; at the base of each cercus a raised membranous, granulate lobe; tenth abdominal tergite with two raised chitinous, rearward pointing processes gradually enlarging and at the tip broadly truncate so as to produce a pointed process on each side; ninth abdominal sternite greatly prolonged into a keel-shaped process, pointed at the lower extremity and with the tip turned up at right angles; ninth sternite at the base with a thickened area in the form of a ventral lobe, but this is only a heavier chitinization and not an appendage.

Female. Hind margin of eighth abdominal sternite partially cleft at the genital opening; ninth abdominal sternite produced into a wide, rounded yellow plate which extends beyond the tip of the abdomen.

Type, No. 11303, female, Mt. Rainier, Wash. (Banks Coll., Mus. Comp. Zool., Cambridge, Mass.); one male, fifteen females, July 16-29, Paradise Valley, Mt. Rainier, Wash. (E. C. VanDyke); three females, Boulder, Colo. (G. S. Dodds); one female, June 30, Kaslo Cr., B. C. (R. P. Currie).

Family CAPNIIDAE.

Small blackish stoneflies, mostly less than 12 mm. in length. Radius and media of forewing fused for a considerable distance at the base and separating from each other at a rather wide angle; cerci composed of a number of segments; middle segment of tarsus very short.

Head as wide or wider than prothorax; lateral tubercles and frontal ridge indistinct; surface almost uniformly dark brown or blackish; three small ocelli, the hind ocelli closer to the eyes than to each other. Antennae long, dark brown.

Prothorax quadrangular or wider than long; angles mostly rounded; surface not very rugose; mostly concolorous. Legs brown or blackish, first and second tarsal segments subequal, second segment very short. Wings present in most forms, though often abbreviated; radius and media of forewing fused at base; one median and one cubital crossvein in forewing and these usually opposite each other; hind wing with a large anal field.

Abdomen brown, cerci composed of few to many segments.

Male. Supra-anal process modified into a recurved probe; subanal lobes small, triangular; ninth abdominal sternite only slightly produced and evenly rounded, without a ventral appendage.

Female. Eighth abdominal sternite not produced into a distinct subgenital plate.

Key to the Genera of Capniidae.

1. Forewing with crossveins between R1 and R2 ___ *Capnura*
   Forewing without crossveins between R1 and R2 2
2. Subcosta ends much before the cord; anal field of hind large and nearly as long as the entire wing; usually no crossvein in the space beyond the tip of subcosta; venation quite irregular; mostly Eastern species ___ *Capnella*
   Subcosta reaches to or nearly to the cord; anal field of hind wing not more than half the length of the wing; usually a crossvein in the space beyond the tip of subcosta; mostly Western species ___ *Capnia*

Genus CAPNIA Pictet.

1841. *Capnia* Pictet, Insectes Neurop., Perlides, 320.
1897. *Arsapnia* Banks, Trans. Amer. Ent. Soc., 24:22.
1907. *Arsapnia* Banks, Cat. Neur. Ins., p. 15.

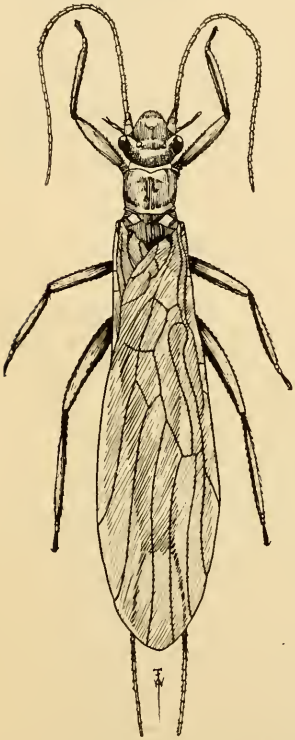

Fig. 28. *Capnia vernalis* Newp.

Small blackish species, mostly less than 10 mm. in length.

Head blackish, wider than prothorax; three small ocelli, the hind ocelli closer to the eyes than to each other; a depressed area just back of the hind ocelli; surface covered with fine pile. Antennae long, dark brown and composed of more than twenty-five segments.

Prothorax as wide or wider than long; surface at most moderately rugose; front angles broadly rounded; sides usually somewhat convex. Legs brown; middle tarsal segment very short; first and third tarsal segments subequal. Wings subhyaline to lightly infuscated; venation not very heavy and quite regular; subcosta reaches at least three-fourth the distance to the cord; an oblique crossvein beyond the end of subcosta; one median and one cubital crossvein (not counting the end ones) and these opposite each other; anal field of hind wing only about half as long as wing and not extending back of the cord.

Abdomen brown. Cerci or tails long (except *A. brevicauda*, in which the cerci are composed of five or six segments) usually as long or longer than the entire body and composed of somewhere near twenty segments.

Male. Supra-anal process recurved over the abdomen in the form of a probe; subanal lobes small, triangular, upcurved, ninth abdominal sternite slightly produced and evenly rounded behind, without a ventral appendage.

Female. Eighth abdominal sternite not produced into a distinct subgenital plate.

Genotype, *Capnia nigra* Pict. (European).

Capnia vernalis Newpt. is the only species of this genus from east of the Rocky Mountains. This genus replaces *Capnella* west of the Rocky Mountains. It differs from *Capnella* in the more regular venation, a longer subcosta, and a shorter anal field in the hind wings.

The males show very distinct specific differences in the structure of the genitalia, but the females can at present not be definitely separated and no attempt has been made to include an analytic key to the females in the species which are known.

Key to the Species of Capnia.

Males.

1. Supra-anal process divided into two or three parts 2
   Supra-anal process composed of a single recurved probe ---- 4
2. Supra-anal process composed of two parts, subequal in length ---- 3
   Supra-anal process composed of three parts, a lower excavated sheath, reaching to the seventh abdominal tergite and two upper processes extending about two-thirds the length of the lower sheath; seventh abdominal tergite with a small median raised process---- *barberi*
3. Seventh abdominal tergite with a median, raised, granulate knob; supra-anal processes slender, gradually tapering to blunt points---- *manitoba*
   Seventh abdominal tergite without a definite median raised knob (although the tergite is humped); supra-anal processes each enlarged toward the tip and bifid---- *columbiana*
4. Supra-anal process slender, gradually tapering to a point ---- 5
   Supra-anal process enlarged beyond the base ---- 11
5. Seventh abdominal tergite with a distinct raised knob or button ---- 6
   Seventh abdominal segment smooth, without a raised knob or button ---- 7
6. Knob on seventh abdominal tergite circular, coarsely granulate, extending considerably over the hind margin of the seventh tergite; supra-

anal process short, reaching to hind margin of eighth tergite, truncate behind ---------- *fibula*

Knob on the seventh abdominal tergite transverse, finely granulate and not extending much over the hind margin of the seventh tergite; supra-anal process long, slender, gradually tapering to a point and extending to the knob on the seventh tergite ---------- *clongata*

7. Supra-anal process very long and slender (about as long as the first seven segments of the cerci) and reaching normally to the middle of the seventh abdominal tergite ---------- 8

Supra-anal process generally not longer than the first 4-5 segments of the cerci, reaching not farther than the middle of the eighth abdominal tergite ---------- 9

8. Small species (5 mm. in length); Sc does not reach the cord; few or no costal crossveins; R sinuate at origin of Rs ---------- *gracilaria*

Large species (15 mm. in length); Sc reaches about to the cord; costal crossveins present; R not sinuate at origin of Rs ---------- *grandis*

9. Eighth abdominal tergite with a small median raised tubercle; supra-anal process not longer than the first three segments of the cerci -- *nana*

Eighth abdominal tergite smooth, without a raised process; supra-anal process longer than the first three segments of the cerci ---------- 10

10. Ninth abdominal tergite with two small raised tubercles, one each side of the median depressed area; Sc reaches almost to the cord; R of forewing sinuate at origin of Rs; supra-anal process normally reaches to middle of eighth tergite; western species ---------- *glabra*

Ninth abdominal tergite without any distinct tubercles; Sc does not reach to the cord; R of forewing sinuate at origin of Rs; supra-anal process normally reaches to middle of ninth tergite; eastern species ---------- *vernalis*

11. Seventh abdominal tergite with a raised knob or button ---------- 12

Seventh abdominal tergite smooth, without a raised knob or button ---------- 14

12. Ninth abdominal tergite with two distinct granulate tubercles, one each side of the median depressed area; supra-anal process short, glo-

bose, smooth; raised process on seventh tergite deeply emarginate behind ..... *tercsa*

Ninth abdominal tergite without tubercles; supra-anal process not globose; raised process on seventh tergite not deeply emarginate 13

13. Supra-anal process short, on the anterior margin with large bristles or spines; process on seventh tergite not much produced backward ..... *tumida*

Supra-anal process quite long, without spines or bristles; process on seventh tergite produced backward considerably ..... *decepta*

14. Eighth abdominal tergite with a raised rounded knob closely beset with short tubercles ..... *nearctica*

Eighth abdominal tergite without a raised rounded knob 15

15. Ninth abdominal tergite with two rounded, hairy knobs, one each side of the median depressed area; eighth tergite largely membranous ..... *californica*

Ninth abdominal tergite smooth, without knobs; eighth tergite with the hind margin produced and apically notched and bearing before the apex a small tubercle ..... *excavata*

Capnia vernalis Newport.

(Plate 47, fig. 6; plate 48, figs. 1, 2.)

1848. *Capnia vernalis* Newport, Proc. Linn. Soc., p. 388.
1851. *Capnia vernalis* Newport, Trans. Linn. Soc., 20:451.
1852. *Capnia vernalis* Walker, Cat., p. 176.
1852. *Nemoura tenuis* Walker, Cat., p. 182.
1861. *Capnia vernalis* Hagen, Ins. Neur. N. A., p. 33.
1892. *Capnia vernalis* Banks, Cat., p. 342.
1907. *Capnia vernalis* Banks, Cat. Neurop., 15.

Length to tip of wings, male, 4.5-5.5 mm.; female, 5.5-6.5 mm. Expanse, male, 7-9 mm.; female, 8-11 mm.

General color black. Head a little wider than prothorax, black, shining; hind ocelli at least three times as close to eyes as to each other. Antennae dark brown to blackish.

Prothorax blackish, slightly rugose; wider than long; front angles broadly, hind angles narrowly rounded; sides somewhat convex. Legs dark brown. Wings somewhat infuscated; wings of male usually shorter than abdomen, of female about as long or longer than abdomen; Sc does not reach to the cord; R very slightly sinuate at origin of Rs; Rs comes off of R at a rather narrow angle. Cerci brown, quite hairy, composed of at least twenty-five

segments, longer than entire body; middle segments at least five times as long as wide.

Male. Abdominal tergites smooth, without any knobs, covered with long hairs; ninth tergite with a narrow median depression; tenth tergite bifid; supra-anal process recurved, slender, tapering to a sharp point and reaching above to hind margin of eighth (normal position); the supra-anal process is grooved; subanal lobes upcurved and bluntly pointed; ninth sternite somewhat produced and evenly rounded behind.

Female. Eighth abdominal sternite unmodified and not produced into a subgenital plate.

The above description pertains to the specimens which have been collected in New York State. Specimens from Michigan agree in general structural details but they are of a brown color instead of black and emerge much later. They are placed here with some doubt.

Distribution.—Originally described from specimens collected at St. Martin's Falls, Albany River, Hudson Bay (Barnston). Many specimens from Mountain Lake, Fulton Co., N. Y., April 26, 1923 (P. W. Claassen); Clinton, N. Y., March, 1903 (P. B. Powell); Highland, N. Y., March 12, 1919; Gilman Lake, Fulton Co., N. Y., April 27, 1923 (P. W. C.); Coy Glen, Ithaca, N. Y., March 30; Isle Royal, Mich., July 14, 1905 (H. A. Gleason).

This is the only species of the genus found east of the Rocky Mountains.

Capnia nana Claassen.

(Plate 48, fig. 3.)

1924. *Capnia nana* Claassen, Can. Ent., 56:46.

Length to tip of wings, male, 5.5 mm. Expanse, male, 7 mm. Length to tip of abdomen, male, 6.5 mm.

General color blackish. Head wider than prothorax, black; ocelli small, the hind ocelli nearly three times as close to eyes as to each other; antennae blackish. Prothorax about as long as wide, blackish; sides nearly straight; angles rounded; surface somewhat rugose, especially toward the center. Legs blackish brown. Wings subhyaline, not reaching to the tip of the abdomen; R in forewing bent upwards at origin of Rs; Rs-M stem of hind wing very short. Abdomen blackish; cerci with more than ten segments (tips broken off).

Male. Eighth abdominal tergite with a small median, raised, chitinized process; ninth and tenth tergites with a median depression; supra-anal process recurved, short,

reaching part way across segment nine; subanal lobes broadly triangular and ending in short spine-like processes; ninth sternite slightly produced and evenly rounded.

Female, unknown.

Holotype, male, March, 1923, Terrace, B. C. (Mrs. W. W. Hippisley, in Cornell University Collection); paratype, male, same locality.

Capnia glabra Claassen.

(Plate 48, fig. 4.)

1924. *Capnia glabra*, Claassen, Can. Ent., 56:55.

Length to tip of wings, male, 4 mm. Expanse, male, 6 mm. Length to tip of abdomen, male, 5.5 mm.

General color brown. Head a little wider than prothorax; dark brown covered with fine pile; hind ocelli about three times as close to eyes as to each other. Antennae brown, composed of about thirty-three segments. Prothorax brown; wider than long; front and hind angles broadly rounded; sides somewhat convex; surface slightly rugose. Legs brown. Wings subhyaline; considerably shorter than abdomen in the male; Sc reaches nearly to the cord; R sinuate at origin of Rs. Abdomen brown. Cerci or tails long, composed of about twenty-five segments, the middle segment about four times as long as wide, end segments about five times as long as wide.

Male. Eighth and ninth abdominal tergites somewhat depressed in the middle; ninth tergite each side with a slightly raised hairy knob; tenth tergite bifid; supra-anal process recurved, slender, bluntly pointed and reaching to the middle of the eighth tergite; subanal lobes triangular, upcurved and ending in short, sharp spines; ninth sternite slightly produced and evenly rounded.

Holotype, male, Dec. 25-26, 1922, Sunnyside Mine near Plumas Co., Calif. (H. S. Barber, in the National Museum, Washington, D. C.); paratypes, many males from the same locality, Dec. 25 to Jan. 24.

Capnia gracilaria Claassen.

(Plate 48, fig. 5.)

1924. *Capnia gracilaria* Claassen, Can. Ent., 56:57.

Length to tip of wings, male, 5 mm. Expanse, male, 8.5 mm.

General color blackish. Head a little wider than prothorax, black; nearly smooth; ocelli very small, the hind ocelli about twice as close to eyes as to each other; an-

tennae blackish. Prothorax wider than long; slightly widened behind; angles rounded; surface slightly rugose in the median region. Legs blackish brown. Wings subhyaline; R of forewing sinuate at the origin of Rs; Sc ends before the cord; stem of Rs-M in hind wing about one-sixth the length of Rs before the cord. Cerci composed of about 16 segments (tips probably broken off).

Male. Abdominal tergites without any knobs or processes except the seventh which has a very slight indication of a small median knob; eighth and ninth tergites with a slight median depression; tenth tergite bifid; supra-anal process recurved, slender and very long, normally reaching to seventh tergite; subanal lobes broadly triangular and terminating in short spine-like processes; ninth sternite slightly produced and evenly rounded.

Female, unknown.

This species is very closely related to *C. grandis* Banks, but is only about one-third as large.

Holotype, male, April 28, 1907, Aweme, Man. (N. Criddle, in Cornell University Collection).

Capnia grandis Banks.

(Plate 48, fig. 6.)

1908. *Arsapnia grandis* Banks, Can. Ent., 37:329.

Length to tip of wings, male, 15 mm. Expanse, male, 25 mm.

General color black with wings lightly infuscated.

Head jet black, very little wider than prothorax, a depression behind the ocellar triangle; entire surface of head rather rugose; covered with fine pile; a depressed triangular area each side of the front ocellus; ocelli form a triangle whose base is a little longer than the sides; hind ocelli more than twice as close to eyes as to each other. Antennae and palpi black.

Prothorax uniformly black, very little narrower than head, not narrowed behind, front and hind margins and sides straight. All angles rounded. Rugosities few but well marked, smooth and shiny; surface covered with fine pile. Legs blackish brown; tibiae a little lighter. Wings uniformly slightly infuscated, veins brown; Sc reaches to the cord; R not sinuate at origin of Rs; Rs comes off of R gradually; five to six costal crossveins before the end of Sc. Rs and M of hind wing with very short basal stem.

Abdomen blackish brown, somewhat lighter at base, covered with fine pile. Cerci or tails brown at base,

black beyond the middle; first segment at least twice as long as wide, the next two segments about twice as wide as long; the segments beyond the middle four or five times as long as wide; quite hairy.

Male. The ninth ventral segment but slightly produced backward, the hind margin evenly rounded; the supra-anal process modified into a very long and slender probe which recurves over the abdomen and reaches at least to the middle of the eighth tergite; subanal lobes triangular, up-curved. There is no tubercle on any of the tergites.

Female, unknown.

Type, male, 11365, Victoria, B. C., April 12, 1907 (Banks Collection, Museum Comparative Zoology, Cambridge, Mass.).

Capnia elongata Claassen.

(Plate 48, fig. 7.)

1924. *Capnia elongata* Claassen, Can. Ent., 56:56.

Length to tip of wings, male, 7 mm. Expanse, male, 12.5 mm.

General color dark brown. Head a little wider than prothorax, brown; occiput marked with longitudinal dark lines; hind ocelli almost twice as close to eyes as to each other. Antennae dark brown.

Prothorax wider than long, dark brown; somewhat widened behind; front angles broadly, hind angles narrowly rounded; surface moderately rugose in the middle portion. Legs dark brown. Wings subhyaline; Sc ends before the cord; R sinuate at origin of Rs. Cerci brown, composed of at least twenty-one segments.

Male. Seventh abdominal tergite with a raised, black, granulate, rounded transverse knob on the hind margin; eighth and ninth tergites with a slight median depression; tenth tergite bifid; supra-anal process recurved, slender, very long, reaching to the knob on the seventh tergite; subanal lobes upcurved and ending in short spine-like processes; ninth sternite slightly produced and rounded.

Female, unknown.

Holotype, male, Jan. 24, 1922, near Caribou, Plumas Co., Calif. (H. S. Barber, in the U. S. National Museum); paratypes, four males from the same locality.

Capnia excavata Claassen.

(Plate 48, fig. 8.)

1924. *Capnia excavata* Claassen, Can. Ent., 56:47.

Length to tip of wings, male, 6.5 mm. Expanse, male, 10.5 mm.

General color blackish brown. Head wider than prothorax, blackish; lateral tubercles large, flat, polished; occiput with longitudinal, polished, interrupted ridges; hind ocelli about three times as close to eyes as to each other; antennae blackish. Prothorax not wider than long; widened behind; angles very broadly rounded; surface moderately rugose, the rugosities blackish. Legs dark brown. Wings lightly fumose; Sc reaches almost to the cord; R of forewing sinuate at origin of Rs. Abdomen brown, cerci brown, with almost twenty segments.

Male. Hind margin of the eighth abdominal tergite produced upward and backward with a slight notch at the apex, and before the apex a small blunt tubercle; supra-anal process recurved, moderately slender at base, but much enlarged before the apex, truncate and ending in a slender pointed process; subanal lobes ending in short, upcurved, spine-like processes; ninth sternite slightly produced and evenly rounded behind.

Female, unknown.

Holotype, male, Jan. 24, 1923, on snow, Feather River Canyon, near Caribou, Plumas Co., Calif. (H. S. Barber, in U. S. National Museum); paratypes, eight males, from same locality.

Capnia tumida Claassen.

(Plate 48, fig. 9.)

1924. *Capnia tumida* Claassen, Can. Ent., 56:47.

Length to tip of wings, male, 7.5 mm. Expanse, male, 12.5 mm.

General color blackish brown. Head a little wider than prothorax; blackish; lateral tubercles large, flat, polished; occiput with a number of longitudinal polished ridges; hind ocelli about twice as close to eyes as to each other; antennae blackish. Prothorax a little wider than long; widened behind; angles broadly rounded; surface moderately rugose, the rugosities blackish. Legs dark brown. Wings lightly fumose; R of forewing bent upwards at origin of Rs. Abdomen dark brown; cerci brown, composed of about nineteen segments.

Male. Seventh abdominal tergite with a raised, black knob which is emarginate behind; ninth and tenth tergites each with a median depression; supra-anal process recurved, bifid, much enlarged at the base and tapering to a blunt double point; on the anterior portion of the bulbous enlargement a row of bristles; the enlargement wider than long, flattened above; subanal lobes ending in

short upturned spine-like processes; ninth sternite slightly produced behind and evenly rounded.

Female, unknown.

Holotype, male, Dec. 25-26, 1922, Sunnyside Mine, near Seneca, Plumas Co., Calif. (H. S. Barber, in the U. S. National Museum); paratypes, seven males, from same locality. Two of these paratypes are in the National Museum and three are in the Cornell University Collection.

Capnia teresa Claassen.

(Plate 48, fig. 10.)

1924. *Capnia teresa* Claassen, Can. Ent., 56:54.

Length to tip of wings, male, 6.5 mm. Expanse, male, 11 mm.

General color brown. Head brown, wider than prothorax; lateral tubercles polished; occiput marked with longitudinal ridges; hind ocelli closer to eyes than to each other; antennae brown; composed of about twenty-six segments. Prothorax a little wider than long, somewhat widened behind; front angles broadly rounded, hind angles narrowly rounded; sides somewhat convex; surface moderately rugose, the rugosities coarse and few in number. Legs brown. Wings subhyaline; Sc reaches to the cord; R of forewing sinuate at origin of Rs. Abdomen brown; cerci brown, composed of about nineteen segments.

Male. Seventh abdominal tergite with a raised, rearward pointing chitinous knob, closely beset with fine spines and deeply emarginate behind; ninth tergite partly cleft and each side of the middle with a raised granulate knob; supra-anal process recurved, enlarged into a somewhat spherical bulb which bears a short pointed process at the tip; subanal lobes upcurved and ending in a spine-like process; ninth sternite slightly produced and broadly rounded behind.

Female, unknown.

Holotype, male, Oct. 15, 1922, Evey's Cañon, Claremont, Calif. (Theresa Robinson, in Cornell University Collection).

This species is rather closely related to *C. tumida* but is smaller, lighter in color and differs in the structure of the genitalia.

Capnia californica Claassen.

(Plate 48, fig. 11.)

1924. *Capnia californica* Claassen, Can. Ent., 56:57.

Length to tip of wings, male, 6.5 mm. Expanse, male, 11 mm.

General color brown. Head wider than prothorax; lateral tubercles large, polished; occiput with longitudinal rugosities; hind ocelli at least three times as close to eyes as to each other; antennae dark brown, darker toward the tip. Prothorax a little wider than long; a little widened behind; angles rounded; surface somewhat rugose; the rugosities mainly in the form of three longitudinal darker irregular lines. Legs brown. Wings subhyaline; R of forewing only slightly sinuate at the origin of Rs. Abdomen brown; cerci brown, composed of about twenty segments.

Male. Hind margin of eighth abdominal tergite deeply emarginate so that there is only a narrow chitinized "collar" in the center, leaving the main portion membranous; ninth tergite with two round, raised, chitinous knobs which are granular and beset with long hairs, the area between the knobs largely membranous; tenth tergite bifid; supra-anal process recurved, short, enlarged, excavated above and bearing on the ventral side near the tip a tooth; subanal lobes triangular, ending in short spine-like processes; ninth sternite slightly produced and evenly rounded.

Female, unknown.

Holotype, male, April 14, 1918, Cazadero, Calif. (E. P. Van Duzee, in the California Academy of Sciences).

Capnia fibula Claassen.

(Plate 48, fig. 12; plate 49, fig. 1.)

1924. *Capinia fibula* Claassen, Can. Ent., 56:56.

Length to tip of wings, male, 7 mm.; female, 9 mm. Expanse, male, 12 mm.; female, 16 mm.

General color dark brown. Head wider than prothorax; lateral tubercles large, dark, flat, polished; occiput somewhat rugose; hind ocelli about twice as close to eyes as to each other. Antennae of male gone, in female composed of thirty-three segments. Prothorax wider than long; sides about straight; front angles broadly rounded; hind angles quite sharp; surface very slightly rugose. Legs brown; wings lightly infuscated; crossvein beyond subcosta originates at the cord; R sinuate at the origin of Rs. Tails long, composed of thirteen or more segments.

Male. Seventh tergite bearing on the median posterior margin a rounded button, closely beset with small papillae; supra-anal process recurved, short, truncate, the tip slightly emarginate; ninth sternite slightly produced and rounded behind, subanal lobes ending in short upcurved spine-like processes.

Female. Eighth sternite not produced into a subgenital plate, but with the hind margin somewhat uneven.

Holotype, male, allotype, female, Las Vegas Hot Springs, N. M., 7,000 feet, Jan. 22, 1902 (T. D. A. Cockrell, in Cornell University Collection.)

Capnia nearctica Banks.

(Plate 49, figs. 2, 3.)

1918. *Capnia nearctica* Banks, Rept. Can. Arct. Exp., Vol. III, Part B, 3B.

Length to tip of wings, male, 3 mm.; female, 6 mm. To tip of abdomen, male, 5.5 mm.; female, 6 mm.

General color black. Head black, wider than prothorax, hairy, lateral tubercles black, smooth; hind ocelli closer to the eyes than to each other; antennae black.

Prothorax wider than long, slightly widened behind; angles rounded; surface moderately rugose. Legs blackish; middle tarsal segment not more than one-fourth as long as the first segment. Wings uniformly but lightly infuscated; veins heavy, brown; wings of male much shorter than abdomen, of female as long as abdomen; subcosta reaches almost to the cord.

Abdomen blackish; cerci or tails dark brown, hairy.

Male. Eighth abdominal tergite with a large rounded knob closely beset with short tubercles and sparsely clothed with fine hair; supra-anal process recurved, bifid dorso-ventrally, enlarged at base and longitudinally striated; subanal lobes triangular, upcurved; ninth abdominal sternite slightly produced and evenly rounded behind.

Female. Hind margin of eighth abdominal sternite little or not at all produced into a subgenital plate.

Type in the Canadian National Collection, Ottawa; paratypes, two females and one male (No. 11296), in the Museum of Comp. Zool., Cambridge, Mass. Collected June 25, 1915, at Bernard Harbor, Northwest Territory, Canada (Canadian Arctic Expedition).

Capnia decepta Banks.

(Plate 49, figs. 4, 5.)

1897. *Arsapnia decepta* Banks, Trans. Am. Ent. Soc., 24:22.
1907. *Arsapnia decepta* Banks, Cat. Neurop., p. 15.

Length to tip of wings, male, 7 mm.; female, 8.5 mm. Expanse, male, 11.5 mm.; female, 14.5 mm.

General color black. Head entirely black, wider than prothorax, a slight depression just behind the ocellar triangle; narrow, black, polished, slightly raised ridges from

the hind ocelli towards the base of antennae. Head covered with yellowish hairs which are quite long on the clypeus and labrum; surface not rugose. Ocelli from an almost equilateral triangle whose base is a little longer than the sides; hind ocelli at least twice as close to eyes as to each other. Antennae dark brown or blackish. Palpi blackish brown.

Prothorax black, narrower than head, wider than long; sides convex, front margin slightly, but evenly rounded; front angles broadly rounded; hind angles more narrowly rounded; surface rugose but the rugosities not very strong; covered with fine yellowish pile. Meso- and metathorax black. Legs brown; in some specimens very dark, in others lighter brown with the femora darker towards the distal end. Wings uniformly hyaline or very slightly fuscous; veins brown; Sc reaches almost to the cord; R sinuate at origin of Rs.

Abdomen dark brown, hairy. Cerci or tails yellowish brown (lighter in the specimens with light brown legs and darker in those with dark legs); slightly darker towards the tip; hairy, shorter hairs all over segments and long hairs on the apical part of the individual segments.

Male. Seventh tergite prolonged backward into a raised rather broad truncate process or tubercle. Supra-anal process recurved and reaching to the process on segment seven; bifid, narrower at the base and much wider in the middle. At the tip it sends a ventral process or tongue under the tubercle on segment seven.

Female. The eighth abdominal sternite is not produced; the middle portion of the segment smooth and somewhat swollen.

Cotypes, male and female, No. 11366, in Banks Collection, Museum Comparative Zoology, Cambridge, Mass.; three females from Colorado, 1853; one female from Steamboat Springs, Colo., May 27.

Capnia columbiana Claassen.

(Plate 49, figs. 6, 7.)

1924. *Capnia columbiana* Claassen, Can. Ent., 56:47.

Length to tip of wings, male, 7 mm.; female, 10 mm. Expanse, male, 12 mm.; female, 17 mm.

General color blackish brown. Head wider than prothorax, blackish; lateral tubercles large, flat, polished; ocelli small, hind ocelli almost three times as close to eyes as to each other; antennae blackish. Prothorax about

as long as wide; sides a little convex; front angles narrowly rounded, hind angles quite sharp; surface very lightly rugose. Legs black. Wings subfumose, the veins heavy; R of forewing sinuate at the origin of Rs; Rs bending down almost at right angles; stem of Rs-M in hind wing short. Abdomen dark brown; cerci blackish, with at least nineteen segments.

Male. Posterior half of the seventh abdominal tergite raised into a narrow, rounded, hairy, transverse ridge; eighth, ninth and tenth tergites with a shallow median depression, supra-anal process composed of two recurved processes, one above the other, equally long, both heavily chitinized, enlarged toward the tip and there bifid; subanal lobes broadly triangular, upcurved; ninth sternite slightly produced and evenly rounded behind.

Female. Eighth abdominal sternite slightly produced; the hind margin with four triangular tooth-like processes in some of the females, while in others the margin is nearly straight.

Holotype, male, allotype, female, March, 1923, Terrace, B. C. (Mrs. W. W. Hippisley, in Cornell University Collection); paratypes, six females.

Capnia manitoba Claassen.

(Plate 47, fig. 4; plate 49, figs. 8, 9.)

1924. *Capnia manitoba* Claassen, Can. Ent., 56:54.

Length to tip of wings, male, 5-5.5 mm.; female, 7.5-8.5 mm. Expanse, male, 8.5-9 mm.; female, 13-14 mm.

General color very dark brown to blackish. Head black, wider than prothorax; covered with fine pile; lateral tubercles large, flat, shiny; hind ocelli closer to eyes than to each other; antennae blackish, composed of about thirty-five to thirty-eight segments. Prothorax black, wider than long, the sides convex; angles rounded; surface rather rugose. Legs dark brown, the femora darker above. Wings fumose, veins dark brown; venation as in plate 47, figure 4. Abdomen blackish. Cerci dark brown, with about eighteen to twenty segments.

Male. Seventh abdominal tergite with a V-shaped incision on the anterior margin and on the posterior half with a large, raised, rounded, finely granulate knob which is slightly emarginate behind; supra-anal process recurved over the tergum, the upper part greatly arched, rod-like, gradually tapering to a point and reaching to the knob on the seventh tergite (natural position). The lower part of the supra-anal process is more slender and lies closely

appressed to the tergum, reaching to the tip of the upper part; subanal lobes ending in short upcurved spine-like processes; tenth tergite medially bifid; ninth sternite slightly produced into an evenly rounded subgenital plate.

Female. Eighth abdominal sternite not produced into a definite subgenital plate.

Holotype, male, allotype, female, April, 28, 1907, Aweme, Man. (N. Criddle, in Canadian Entomological Collection, Ottawa, Can.); paratypes, six males and five females, from same locality.

Capnia barberi Claassen.

(Plate 49, fig. 10.)

1924. *Capnia barberi* Claassen, Can. Ent., 56:55.

Length to tip of wings, male, 5 mm. Expanse, male, about 8 mm.

General color dark brown. Head wider than prothorax, dark brown; occiput slightly rugose; hind ocelli about twice as close to eyes as to each other; antennae dark brown with about thirty-one segments; palpi brown. Prothorax brown, wider than long; front angles broadly rounded, hind angles more narrowly rounded; widened posteriorly; sides somewhat convex; surface moderately rugose. Legs brown. Wings uniformly subhyaline; veins dark brown; in forewing Rs comes off of radius at a very broad angle. (The wings in this specimen are in rather poor condition, not being fully expanded.) Antennae brown; cerci brown (one absent, the other with only twelve segments present).

Male. Seventh abdominal tergite with a narrow, sharp chitinized tubercle; supra-anal process recurved, composed of three parts, a lower excavated sheath which extends to the tubercle, and two pointed processes about two-thirds as long as the sheath; subanal lobes short, triangular; ninth sternite slightly produced into an evenly rounded subgenital plate, which bears a short tubercle behind; ninth tergite partly divided, tenth tergite bifid.

Female, unknown.

Holotype, male, Jan. 24, 1923, on snow, Feather River Canyon, near Caribou, Plumas Co., Calif., Sunnyside Mine, near to Belden (H. S. Barber, in Collection of U. S. National Museum).

Capnia bakeri Banks.

(Plate 49, fig. 11.)

1918. *Arsapnia bakeri* Banks, Bull. Mus. Comp. Zool., Harvard 62, No. 1:9.

Length to tip of wings, female, 9.5 mm. Expanse, female, 17 mm.

General color blackish brown, wings slightly infuscated. Head dark brown with black rugosities; wider than the prothorax. A depressed area between the hind ocelli and one each side of the front ocellus; a black narrow polished mark extends from the hind ocelli towards the base of the antennae, and two large black polished slightly raised marks on the clypeus; occiput with a number of black longitudinal broken lines; head covered with fine pile. Ocelli form an almost equilateral triangle whose base is a little longer than the sides, hind ocelli closer to the eyes than to each other, but hardly twice as close. Antennae yellowish brown except the two basal segments which are dark brown; hairy; middle segments about three times as long as wide. Palpi light brown.

Prothorax dark brown with black rugosities; covered with fine pile; a little narrower than head, wider than long; slightly narrowed behind; front margin slightly rounded; front angles broadly rounded; sides convex; hind angles narrowly rounded; surface quite rugose. Legs yellowish or light brown; femora a little darker towards the distal ends; tarsi dark. Wings slightly infuscated, an infuscated spot at the cord and somewhat infuscated at the tips of the wings; veins dark brown; Sc does not reach the cord; R not sinuate at origin of Rs.

Abdomen blackish brown. Cerci or tails yellowish at base, darker beyond middle. Segment two about as long as wide, the segments beyond the middle about four times as long as wide, hairy.

Female. The eighth ventral segment only very slightly produced in the middle, uniformly blackish brown and somewhat swollen in the middle.

Male, unknown.

Type, female, No. 10053, mountains near Claremont, Calif. (C. F. Baker, in Banks Collection, Museum of Comparative Zoology, Cambridge, Mass.).

The female type is not in very good condition, the prothorax being rather badly twisted and the subgenital plate somewhat shriveled.

Capnia brevicauda Claassen.

(Plate 47, fig. 2; plate 49, fig. 12.)

1924. *Capnia brevicauda* Claassen, Can. Ent., 56:55.

Length to tip of wings, female, 6-6.5 mm. Expanse, female, 10-10.5 mm.

General color dark brown. Head wider than prothorax; dark brown; frontal ridge black; large, black, flat, polished lateral tubercles; a large rounded black spot back of each hind ocellus; hind ocelli only about two diameters distant from the eyes. Prothorax about as long as wide; sides nearly straight; front angles broadly rounded, hind angles quite sharp; surface slightly rugose; three narrow median longitudinal black lines and a narrow black line completely surrounding the inner disc. Legs dark brown. Wings uniformly fumose; crossvein beyond Sc about half way between the cord and the tip of wing; R not sinuate at origin of Rs. Cerci short, composed of four or five segments.

Male, unknown.

Female. Eighth sternite unmodified and not produced into a subgenital plate.

Holotype, female, Boulder, Colo. (G. S. Dodds, in Cornell University Collection); paratypes, four females, from the same locality.

Okamoto has recently made a new genus (*Eucapnopsis*) for the species with short cerci, however the venation and other characters are typical of *Capnia*.

Capnia crinita, new species.

(Plate 33, fig. 6.)

Length to tip of wings, female, 16 mm. Expanse, 28 mm.

A large blackish hairy species. Head slightly wider than prothorax, blackish; hind ocelli closer to the eyes than to each other; antennae blackish, covered with long hairs.

Prothorax wider than long, slightly narrowed behind; front angles broadly rounded, hind angles narrowly rounded; front and lateral margins brown, rest of pronotum blackish; surface quite rugose and very hairy. Legs blackish. Wings subhyaline; veins rather heavy brown; 5-6 costal crossveins before the end of subcosta and 2-3 beyond; in the hind wing the costal space is very wide, much wider than in other species of this genus; the wings on the left side of the specimen have several crossveins between the branches of the radial sector—three in the front wing and two in the hind wing; there are no such crossveins in the wings on the right side.

Abdomen brown with long blackish hairy tails.

Male, unknown.

Female. Hind margin of eighth abdominal sternite not produced but rather emarginate in the middle.

Holotype, female, Montana Experiment Station, Bozeman, Mont., May 12, 1917 (R. A. Cooley, in Cornell University Collection).

Genus CAPNURA Banks.

1900. *Capnura* Banks, Trans. Am. Ent. Soc., 26:245.
1907. *Capnura* Banks, Cat. Neurop., p. 15.
1909. *Capnura* Enderlein, Zool. Anz., 34:391.

Small blackish stoneflies 10-12 mm. in length, very similar to *Capnia* Pict.

Head black, pilose with three ocelli, the hind ocelli closer to the eyes than to each other; a depressed area between the hind ocelli; antennae long, submoniliform.

Prothorax blackish, narrower than head; surface only lightly rugose, front angles broadly rounded, somewhat narrowed behind. Legs dark, first and third tarsal segments subequal, second segment about one-fourth as long as first. Wings subhyaline or lightly infuscated; veins dark but not heavy; few or no costal crossveins; several irregular crossveins between R1 and R2-3 and sometimes one between R2-3 and R4-5; only one median and one cubital crossvein in forewing (not counting end ones); anal field of hind wing containing three veins.

Abdomen dark brown; setae or tails long, composed of twelve or more hairy segments.

Male, unknown.

Female. Hind margin of eighth abdominal sternite not produced into a distinct subgenital plate.

Genotype, *Capnura venosa* Bks.

This genus contains one species of which only the females are known.

Capnura venosa Banks.

(Plate 47, fig. 7; plate 49, fig. 13.)

1900. *Capnura venosa* Banks, Trans. Am. Ent. Soc., 26:245.
1907. *Capnura venosa* Banks, Cat. Neurop., p. 15.

Length to tip of wings, female, 10 mm. Expanse, 18 mm.

General color black, the wings slightly infuscated.

Head black, covered with rather long hairs. A depressed area between the hind ocelli and another one just back of the front ocellus. Lateral tubercles large, flat,

polished; clypeus quite rugose. The ocelli form an almost equilateral triangle whose base is a little longer than the sides; hind ocelli about twice as close to eyes as to each other. Antennae black, submoniliform; third segment a little longer than second; fourth equals second in length. Palpi black, short.

Prothorax black, narrower than head, wider than long, narrowed behind; sides convex in front and middle, front angles very broadly rounded, hind angles narrowly rounded; surface coarsely rugose and hairy. Meso- and metathorax black, hairy. Legs brown or blackish. In the specimens with lighter legs the femora are darker towards the tips. First and third tarsal segments subequal; second segment short, not more than one-fourth as long as first. Wings uniformly and lightly infuscated, veins dark brown, several crossveins between R1 and R2 beyond the cord in both fore and hind wings. Venation as in plate 47, figure 7.

Abdomen blackish brown, somewhat lighter towards the tip, covered with rather long hair, the tip of the abdomen being especially hairy. Cerci or tails submoniliform, dark brown, very hairy, the hairs longer than the basal segments, which are about as long as wide; beyond the middle the segments are three to four times as long as wide.

Male, unknown.

Female. The eighth abdominal sternite truncate and not noticably produced.

Distribution.—Four females, including type 11364, from Pullman, Wash., April 9, 1897 (Banks Collection, Museum of Comparative Zoology, Cambridge, Mass.); one female, Pullman, Wash., March 16, 1909 (W. M. Mann).

Genus CAPNELLA Claassen.

1924. *Capnella* Claassen, Can. Ent., 56:43.

Small blackish species, mostly under 10 mm. in length; usually winged, the males often short-winged and in at least one species the males are wingless.

Head blackish, wider than prothorax; ocelli three, the hind ocelli closer to the eyes than to each other. Antennae blackish, long.

Prothorax usually a little wider than long; angles rounded; surface slightly to moderately rugose. Legs nearly uniformly brown or blackish; middle tarsal segment very short; first and third tarsal segments subequal. Wings subhyaline, with heavy irregular venation, the

veins often ending blindly; subcosta short, usually not reaching farther than to a point half way between the origin of Rs and the cord; no crossvein beyond the end of Sc, or if present it is very near the tip of R1; anal field of hind wings large and nearly as long as the rest of the wing.

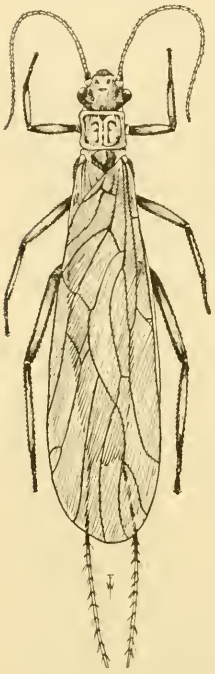

Fig. 29. *Capnella pygmaea* Burm.

Abdomen blackish, cerci or tails long, composed of many (fifteen or more) segments.

Male. Supra-anal process recurved upon the dorsum of the abdomen and divided into two parts, an upper chitinized process which serves as a probe and a lower excavated sheath in which the upper probe rests; eighth abdominal tergite usually bears a single or double knob, under or against which the supra-anal process fits; ninth and tenth abdominal tergites with a median longitudinal groove in which the supra-anal process normally lies (this results in the bifid appearance of these two tergites); subanal lobes small, somewhat triangular; ninth abdominal sternite slightly produced and evenly rounded behind, without any ventral appendage.

Female. Hind margin of eighth abdominal sternite very little or not at all produced; genital opening not guarded by valves.

Genotype, *Capnella granulata* Clsn.

There is considerable variation in the length of the wings within the same species. Venational characters serve for generic distinction but there is so much variation that they are of no value in separating the species. The genitalia of the males furnish excellent characters for specific determination; however, in the females the genital structures are of little value as key characters. No attempt is made to furnish an analytic key for the determination of the females.

Key to the Species of Capnella.

Males.

1. Eighth abdominal tergite (antepenultimate segment) with a single, raised, chitinous tubercle or knob ---------- 2
   Eighth abdominal tergite with two raised, chitinous tubercles or knobs ---------- 4
2. Wingless; knob on eighth abdominal tergite narrow, transverse; supra-anal processes long, about as long as the first 7 or 8 segments of the cerci or tails ---------- *vivipara*
   Winged, although the wings may be much abbreviated; knob on eighth abdominal tergite round or nearly so, never transverse; supra-anal processes not longer than the first 5 or 6 segments of the cerci ---------- 3
3. Knob on eighth abdominal tergite consists of a continuation of the hind margin of the eighth tergite, directed backward; lower sheath of supra-anal process notched on each side before the apex ---------- *incisura*
   Knob on eighth abdominal tergite placed before the hind margin of the eighth tergite, not directed backwards; lower sheath of supra-anal process not notched before the apex ---------- *recta*
4. Tubercles on eighth abdominal tergite blunt and placed before the hind margin of the eighth tergite; upper part of supra-anal process with a bulbous enlargement at the tip ---------- *pygmaea*
   Tubercles on eighth abdominal tergite pointed, continuous with the hind margin of eighth tergite, directed backward; beneath each of the larger tubercles is a small tubercle; upper part of supra-anal process not with a bulbous enlargement at the tip ---------- *granulata*

Capnella granulata Claassen.

(Plate 47; figs. 3, 5; plate 50, figs. 6, 7.)

1924. *Capnella granulata* Claassen, Can. Ent., 56:44.

Length to tip of wings, male, 3-3.5 mm.; female, 6-7 mm. Expanse, male, 4-5 mm.; female, 11-12.5 mm.

Length to tip of abdomen, male, 5-6 mm.

General color dark brown to blackish. Head a little wider than prothorax; lateral tubercles large, flat, polished; head covered with rather long whitish pile; ocelli

small; hind ocelli nearly three times as close to eyes as to each other. Antennae dark brown, with about 30 segments. Prothorax wider than long, rather coarsely punctuate; slightly rugose; front angles very broadly rounded, hind angles narrowly rounded; slightly narrowed behind. Legs brown. Wings of male short, not reaching over more than two or three abdominal segments; wings of female as long or little longer than abdomen; wings uniformly subhyaline; veins heavy and dark. Sc reaches to a point about half way between the origin of Rs and the cord; anal field of hind wing nearly as long as the entire wing. Abdomen brown. Cerci brown, composed of 15-17 segments.

Male. Eighth abdominal tergite raised into a rearward pointing process which is bifid at the tip so as to form two granulate tubercles; each of these tubercles with a smaller tubercle below; supra-anal process modified into a double recurved process, the upper part chitinous, elbowed at the middle, at the tip enlarged, and above with a median groove; the lower part in the form of a hollowed out sheath with a notch on the lateral margin before the tip; subanal lobes terminating in short upcurved spine-like processes; ninth sternite slightly produced into an evenly rounded subgenital plate.

Female. Eighth abdominal sternite not distinctly produced into a subgenital plate.

Distribution.—Holotype, male, allotype, female, Mar. 14, 1908, Johnstown, N. Y. (Cornell University Collection); many males and females, Mar. 14, 1908, Johnstown, N. Y.; males and females, Fulton Co., N. Y. (C. P. Alexander); one male, March 1, 1902, Washington, D. C. (H. S. Barber); males and females, Feb. 12, 1906, near Embarras R. Coles Co., Ill.; males and females, March 3, 1903, Plummer's Island, Maryland; males and females, March 25, 1920, Adams Center, N. Y. (P. W. Claassen).

Capnella recta Claassen.

(Plate 50, figs. 8, 9.)

1924. *Capnella recta* Claassen, Can. Ent., 56:44.

Length to tip of wings, male, 3-4 mm.; female, 5-6 mm. Expanse, male, 4-6 mm.; female, 7-8.5 mm. Length to tip of abdomen, ♂, 4-5 mm.

General color dark brown to blackish. Head dark brown, smooth, wider than prothorax; hind ocelli about twice as close to eyes as to each other.

Prothorax brown, a little wider than long, somewhat

widened behind; angles narrowly rounded; surface slightly rugose. Legs brown. Wings of male abbreviated, reaching only about half the length of abdomen in some males, while in others they reach nearly to the tip of the abdomen; wings of female reach almost to tip of abdomen; venation very irregular; anal field of hind wings nearly as long as wing. Abdomen brown (last two or three segments blackish in male); cerci composed of about 15 segments.

Male. Just before the raised hind margin of eighth abdominal tergite occurs a black, blunt rounded tubercle, finely granulate above and directed cephalad; supra-anal process recurved, short and divided into two parts, the upper flat, heavily chitinized, bluntly rounded at tip and above, closely beset with short hairs, the lower process in the form of a hollowed out sheath with an enlarged bulbous tip and without any notches on the margin; ninth tergite with a depressed membranous area, tenth tergite bifid; ninth sternite slightly produced and evenly rounded; subanal lobes triangular, ending in short spine-like processes.

Female. Eighth abdominal sternite unmodified.

Distribution.—Holotype, male, allotype, female, March 16, Ithaca, N. Y. (Cornell University Collection); many species, mostly males, Ithaca, March; two males, Interlaken, N. Y., Nov. 21, 1912; one male, two females, Feb. 16, 1907, Dedham, Mass. (G. M. Allen).

Capnella incisura Claassen.

(Plate 50, figs. 10, 11.)

1924. *Capnella incisura* Claassen, Can. Ent., 56:45.

Length to tip of wings, male, 3 mm.; female, 5-5.5 mm. Expanse, male, 4 mm.; female, 8-8.5 mm. Length to tip of abdomen, male, 3.4 mm.; female, 5 mm.

General color dark brown to blackish. Head wider than prothorax; dark brown; occiput with longitudinal darker lines; hind ocelli at least three times as close to eyes as to each other. Antennae with about 22-25 segments. Prothorax quadrangular, slightly widened behind; angles rounded; surface nearly smooth. Legs brown. Wings of male reaching over one-half to two-thirds of abdomen, of female as long or slightly longer than abdomen; anal field of hind wings nearly as long as rest of wing. Abdomen of female above with a broad median light longitudinal band which extends to the hind margin of the eighth tergite; tergites nine and ten evenly chitinized; male abdomen

without a longitudinal stripe; cerci brown, with about 13-15 segments.

Male. Hind margin of the eighth abdominal tergite raised into a single rearward pointing blunt tubercle; tergites 9 and 10 with a broad median groove or depression into which the supra-anal process fits; this process recurved, divided into two parts, the upper flattened, bluntly pointed, the lower in the form of a hollowed out sheath with a narrow notch on the margin just before the bulbous enlargement; ninth abdominal sternite slightly produced and evenly rounded behind; subanal lobes terminating in short upcurved sharp processes.

Female. Hind margin of eighth abdominal sternite not produced into a subgenital plate; the middle field of the eighth sternite depressed, with two longitudinal outcurved dark lines.

Distribution.—Holotype, male, allotype, female, March 15, 1907, Ithaca, N. Y. (Cornell University Collection); many males and females, March 3-30, Ithaca, N. Y.; four males, four females, March 12, Orono, Me.; males and females, March 20, 1924, Harmony, Col. Co., Nova Scotia (W. H. Brittain).

Capnella vivipara Claassen.

(Plate 50, figs. 4, 5.)

1924. *Capnella vivipara* Claassen, Can. Ent., 56:46.

Length to tip of abdomen, male, 4.5-6.5 mm.; female, 7-8 mm. Expanse, female, 5-7 mm.

General color brown. Head brown, slightly wider than prothorax; surface covered with fine pile; occiput somewhat rugulose; hind ocelli at least twice as close to eyes as to each other; antennae brown, darker toward the tip. Prothorax brown, slightly wider than long, somewhat widened posteriorly; angles rounded; surface slightly rugose. Legs brown; wings absent in the males; very short in the female, not reaching half the length of abdomen. Abdomen brown, somewhat darker toward the tip; cerci brown, composed of about 15 segments.

Male. Eighth abdominal tergite with a black, narrow, transverse, raised tubercle before the hind margin; supra-anal process recurved, long, divided into two parts, the upper angulate, heavily chitinized and at the tip enlarged, the lower in the form of a hollowed out sheath, enlarged towards the tip and with a broad notch on the margin before the tip; subanal lobes triangular, upcurved and end-

ing in sharp points; ninth sternite slightly produced and evenly rounded.

Female. Hind margin of eighth abdominal sternite not produced into a subgenital plate.

Distribution.—Holotype, male, allotype, female, April 30, Lake Forest, Ill. (Cornell University Collection); many females and one male, Apr. 30, Lake Forest, Ill.; many males and several females, March 16, Ithaca, N. Y.; two males, one female, March 7, 1908, Ithaca, N. Y.; two males, six females, April 7, Columbia, Mo. (C. R. Crosby); four males, eight females, March 21, 1920, Bluff Point, N. Y.; three males, Feb. 9, 1919, Salineville, Ohio.

Capnella pygmaea Burmeister.

(Plate 47, figs. 1, 8; plate 50, figs. 1-3.)

1839. *Semblis pygmaea* Burmeister, Handb., 2:874.
1841. *Capnia pygmaea* Pictet, Perlides, p. 324.
1842. *Capnia pygmaea* Pictet, Ins. Neurop., p. 324.
1852. *Capnia pygmaea* Walker, Cat., p. 175.
1861. *Capnia pygmaea* Hagen, Syn. Neurop. N. A., p. 32.
1869. *Capnia pygmaea* Bethune, Can. Ent., 1:81.
1876. *Capnia pygmaea* Provancher, Nat. Cand., 8:125-127.
1892. *Capnia pygmaea* Banks, Cat., p. 342.
1904. *Capnia pygmaea* Banks, Proc. Ent. Soc. Wash., 6:205.
1907. *Capnia pygmaea* Tucker, Kans. Univ. Sci. Bull., 4:78.
1907. *Capnia pygmaea* Banks, Cat. Neurop., p. 15.
1924. *Capnella pygmaea* Claassen, Can. Ent., 56:43.

Length to tip of wings, male, 3-3.5 mm.; female, 6-7.5 mm. Expanse, male, 4-4.5 mm.; female, 8.5-12 mm.

General color dark brown to blackish. Head blackish, wider than prothorax, quite smooth, occiput with faint longitudinal darker lines; hind ocelli about twice as close to eyes as to each other. Antennae blackish, with about 26-28 segments. Prothorax a little wider than long, widened behind, lightly rugose; angles rounded. Legs brown. Wings of male short, generally not reaching beyond the fourth abdominal segment, although some of the males are long winged; wings of female reaching to about the tip of abdomen. Abdomen of female with a broad light median longitudinal band extending to the hind margin of segment eight; tergites nine and ten evenly chitinized; male abdomen without longitudinal band. Tails blackish, with about 15 segments.

Male. Eighth abdominal tergite raised into a double pointed tubercle; tergites 9 and 10 with a broad median groove or depression into which the supra-anal process fits; the process is recurved, long, and divided into two parts, the upper angulate dorsally, deeply grooved,

with a slightly enlarged bulb at the tip, the lower in the form of a hollowed out sheath with even margins; subgenital plate short, somewhat triangular behind; subanal lobes terminating in short, upcurved spines.

Female. Eighth sternite hardly produced into a subgenital plate; a narrow, transverse black line between the seventh and eighth sternite and usually the hind margin of the eighth sternite is more heavily chitinized.

Distribution.—The male type of Burmeister from Pennsylvania is in the Zoological Museum, Halle, Germany. We have examined specimens from Maine, Waldeboro, March-May (J. N. Lovell); New Hampshire, Jeffrey, March 14, 1917 (C. W. Johnson); Mass., Methuen, April 3; New York, Ithaca, Feb.-April; McLean, May 9; Northville, Hamilton Co., April 27, 1923; Staten Island, Feb. 12; Mosholu, March 28; Pike, May 13 and April 2; Maryland, Cabin John Bridge, Feb. 26 and March 12 (R. C. Shannon); Plummer's Island, Feb. 23 (W. V. Warner); District of Columbia, Washington, Feb. 9, 1913 (Alex. Wetmore); March 1, 1902 (H. S. Barber); Virginia, Dead Run, Fairfax Co., Feb. 24 (H. S. Barber).

Through the courtesy of Dr. Walther Horn of the Berlin Zoological Museum, we have had the opportunity of examining Burmeister's types of this species. One of the two males which Burmeister ascribed to this species is *Capnella recta* Clsn.; the other specimen agrees exactly with his original description and undoubtedly is the type.

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Note.—We have not aimed at completeness for the world fauna but only for North America north of Mexico. Important papers dealing with the difficult species of Nemouridae after the modern method, written by such excellent students of the European fauna as Morton, Ris and Kempny, we have not included, though one who studies this group in America should be acquainted with them. We have cited a few general papers on exotic forms because they contain material relevant to the study of American forms—papers by Imhof, Lauterborn, Ris, Okamoto and Tillyard.

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SYSTEMS OF CLASSIFICATION

Below we present a tabular statement of the principal systems that have been proposed for dividing the order Plecoptera into sub-orders and families.

PICTET 1842	NEEDHAM 1901	ENDERLEIN 1909	KLAPALEK 1909	TILLYARD 1922	THIS WORK 1925
		HOLOGNATHA[1]	FILIPALPIA[2]	Eustheniidae	
		Gripopterygidae	Gripopterygidae	Leptoperlidae	*
				Austroperlidae	
		Capnidae	Capnidae	Capnidae	Capnidae
			Taeniopterygidae		
	Nemouridae	Nemouridae	Nemouridae	Nemouridae	Nemouridae
			Leuctridae		
Perlidae		SYSTELLOGNATHA[1]			
		Pteronarcidae	Pteronarcidae	Pteronarcidae	Pteronarcidae
			SUBULIPALPIA[2]		
	Perlidae	Perlidae	Perlidae	Perlidae	Perlidae
			Perlodidae		

*Not treated here, because not regional: Distribution confined to the southern parts of the Southern Hemisphere, Australia, New Zealand, Chili, etc.
Sub-orders proposed by Enderlein:
[1]HOLOGNATHA: with well developed mandibles.
[1]SYSTELLOGNATHA: with rudimentary mandibles.
Sub-orders proposed by Klapalek:
[2]SUBULIPALPIA: terminal palpal segments as thick as the others.
[2]FILIPALPIA: terminal palpal segments successively more slender.
Neither of these conflicting primary divisions of the order appears to be based on fundamental characters. Tillyard (l. c. p. 7) a useful table of characters by families. All these authors agree that two divergent lines of specialization culminate in the families Nemouridae gives and Perllidae respectively.

LIST OF THE SPECIES HEREIN TREATED

arranged under the subgenera heretofore proposed in so far as we have been able to recognize such groups. To these we have added a few new names for equivalent groups, all of them alike based on very small differences, and of little or no taxonomic importance.

Family PTERONARCIDAE

1. Genus Pteronarcys Newman
   Subgenus Pteronarcys
   1. *P. dorsata* Say
      regalis Newman
   2. *P. nobilis* Hagen
      pictetii Hagen
   3. *P. californica* Newport
   4. *P. princeps* Banks
   Subgenus Allonarcys (nov.)
   5. *P. proteus* Newman
      spinosa Banks
   6. *P. biloba* Newman
      bicarinatus Provancher
   7. *P. comstocki* Smith
      proteus Newman (♀)
2. Genus Pteronarcella Banks
   8. *P. regularis* Hagen
   9. *P. badia* Hagen
      torosa Smith
      triloba Smith

Family PERLIDAE

3. Genus Perlodes Banks
   Dictyopteryx Pictet
   Subgenus Perlodes Banks
   Protarcys Klapalek
   Megarcys Klapalek
   Arcynopteryx Klap.
   10. *P. dolobrata* Smith
   11. *P. bradleyi* Smith
   12. *P. tibialis* Banks
   13. *P. signata* Hagen
   14. *P. yosemite*, new species
   15. *P. irregularis* Banks
   16. *P. slossonae* Banks
       inornata Smith
   17. *P. lineata* Smith
   18. *P. americana* Klapalek
   19. *P. aurea* Smith
   20. *P. ignota* Smith
   21. *P. minor* Klapalek
   Subgenus Perlinodes (nov.)
   22. *P. vagans* Smith
4. Genus Isogenus Newman
   Nephelion Pictet
   23. *I. frontalis* Newman
       sulcata Provancher
       titusi Banks
       incesta Banks
   24. *I. elongatus* Hagen
   25. *I. colubrinus* Hagen
5. Genus Perla Geoffroy
   Subgenus Hemimelaena Klapalek
   26. *P. innubila*, new species
   27. *P. alameda*, new species
   28. *P. crosbyi*, new species
   29. *P. expansa* Banks
   30. *P. postica* Walker
   31. *P. varians* Walsh
   32. *P. hastata* Banks
   33. *P. fugitans*, new species
   34. *P. nona*, new species
   35. *P. aestivalis*, new species
   36. *P. modesta* Banks
   37. *P. verticalis* Banks
       isolata Banks
   38. *P. tincta*, new species
   39. *P. sorpta*, new species
   40. *P. phalerata* Smith
   41. *P. obscura*, new species
   42. *P. venosa*, new species
   Subgenus Diploperla (nov.)
   43. *P. duplicata* Banks
   44. *P. bilobata*, new species
   Subgenus Neophasganophora Lestage.
   Phasganophora Klapalek
   45. *P. capitata* Pictet
       tristis Hagen
       annulipes Hagen
       flavescens Walsh
       hieroglyphica Provancher
       marginipes Provancher
       americana Banks
       illustris Banks
       innota Banks
   Subgenus Perla Geoffroy
   46. *P. luctuosa* Banks
   47. *P. ramosa*, new species
   48. *P. kansensis* Banks
   49. *P. languida*, new species
   50. *P. sabulosa* Banks
   Subgenus Togoperla Klapalek
   51. *P. immarginata* Say
       fumosa Banks
   52. *P. media* Walker
6. Genus Alloperla Banks
   53. *A. pallidula* Banks
       infirma Banks
   54. *A. marginata* Banks

55. *A. pacifica* Banks
56. *A. lateralis* Banks
57. *A. novascotiana*, new species
58. *A. coloradensis* Banks
59. *A. lamba*, new species
60. *A. albertensis*, new species
61. *A. continua* Banks
62. *A. borcalis* Banks
63. *A. fidelis* Banks
64. *A. spatulata*, new species
65. *A. signata* Banks
66. *A. mediana* Banks
67. *A. lineosa* Banks
68. *A. pilosa*, new species
69. *A. serrata*, new species
70. *A. imbecilla* Say
71. *A. nanina* Banks

7. Genus Chloroperla Newman
Isopteryx Pictet
72. *C. cydippe* Newman

8. Genus Paraperla Banks
73. *P. frontalis* Banks

9. Genus Kathroperla Banks
74. *K. perdita* Banks

10. Genus Neoperla Needham
Pseudoperla Banks
Ochthopetina Enderlein
75. *N. clymene* Newman
occipitalis Pictet

11. Genus Clioperla, new genus
76. *C. similis* Hagen
77. *C. gravitans*, new species
78. *C. clio* Newman
79. *C. annecta*, new species
80. *C. ebria* Hagen
81. *C. marmorata*, new species
82. *C. sobria* Hagen
83. *C. slossonae* Banks

12. Genus Isoperla Banks
84. *I. fusca*, new species
85. *I. minuta* Banks
86. *I. marlynia*, new species
87. *I. signata* Banks
88. *I. ventralis* Banks
89. *I. bellona* Banks
90. *I. 5-punctata* Banks
91. *I. sordida* Banks
92. *I. marmona* Banks
93. *I. bilineata* Say
94. *I. montana* Banks
95. *I. longiseta* Banks

13. Genus Perlesta Banks
96. *P. placida* Hagen
decipiens Walsh
bruneipennis Walsh
virginica Banks
cinctipes Banks
texana Banks
costalis Klapalek
virginica var. immaculata Klapalek

14. Genus Atoperla Banks
97. *A. ephyre* Newman
producta Walsh
fumipennis Walsh

15. Genus Perlinella Banks
98. *P. drymo* Newman
elongata Walsh
trivittata Banks

16. Genus Peltoperla Needham
99. *P. cornelia*
Needham and Smith
dorothea
Needham and Smith
ada
Needham and Smith
100. *P. anna*
Needham and Smith
101. *P maria*
Needham and Smith
102. *P. arcuata* Needham
103. *P. thyra*
Needham and Smith
104. *P. brevis* Banks
105. *P. cora*
Needham and Smith

17. Genus Acroneuria Pictet
Subgenus Acroneuria Pictet
Nosatura Navas*
106. *A. abnormis* Newman
sonans Newport
107. *A. arenosa* Pictet
108. *A. ruralis* Hagen
109. *A. pennsylvanica* Rambur
110. *A. trijuncta* Walker
111. *A. internata* Walker
112. *A. arida* Hagen
valida Banks
113. *A. evoluta* Klapalek
114. *A. pacifica* Banks
nigrita Banks
115. *A. pumila* Banks
116. *A. lycorias* Newman
navalis Provancher
excavata Banks
117. *A. carolinensis* Banks

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*Mem. Real. Acad. Barcelona (2) 14: 339-366. This paper we have not seen. The name is placed here because *Perla carolinensis* Banks is cited as type.

118. *A. depressa* Needham and Claassen
119. *A. theodora* Needham and Claassen
120. *A. californica* Banks
concolor Banks

Subgenus Croceneuria (nov.)†

121. *A. xanthenes* Newman

Subgenus Beloneuria (nov.)

122. *A. georgiana* Banks

Family NEMOURIDAE

18. Genus Nemoura Latreille

Subgenus Nemoura Latreille
Protonemoura Kempny
Amphinemoura Ris
Nemourella Kempny

123. *N. glabra* Claassen
124. *N. frigida* Claassen
125. *N. divergens* Claassen
126. *N. columbiana* Claassen
127. *N. delicatula* Claassen
128. *N. bifurcata* Claassen
129. *N. biloba* Claassen
130. *N. flexura* Claassen
131. *N. depressa* Banks
132. *N. cornuta* Claassen
133. *N. californica* Claassen
134. *N. sinuata* Wu
135. *N. venusta* Banks
136. *N. venosa* Banks
stylata Banks
137. *N. coloradensis* Banks
138. *N. producta* Claassen
139. *N. cinctipes* Banks
140. *N. oregonensis* Claassen
141. *N. trispinosa* Claassen
142. *N. similis* Hagen
143. *N. vallicularia* Wu
144. *N. carolinensis* Claassen
145. *N. nevadensis* Claassen
146. *N. washingtoniana* Claassen
147. *N. interrupta* Claassen
148. *N. truncata* Claassen
149. *N. serrata* Claassen
150. *N. prolongata* Claassen
151. *N. rotunda* Claassen
152. *N. stigmata* Banks

Subgenus Paranemoura (nov.)

153. *N. punctipennis* Claassen

19. Genus Leuctra Stephens

154. *L. augusta* Banks
155. *L. biloba* Claassen
156. *L. bradleyi* Claassen
157. *L. carolinensis* Claassen
158. *L. decepta* Claassen
159. *L. duplicata* Claassen
160. *L. glabra* Claassen
161. *L. grandis* Banks
162. *L. hamula* Claassen
163. *L. infuscata* Claassen
164. *L. occidentalis* Banks
165. *L. sibleyi* Claassen
166. *L. tenuis* Pictet
167. *L. triloba* Claassen
168. *L. truncata* Claassen

20. Genus Perlomyia Banks

169. *P. collaris* Banks
170. *P. utahensis*, new species

21. Genus Taeniopteryx Pictet

Subgenus Nephelopteryx Klapalek

171. *T. maura* Pictet
172. *T. nivalis* Fitch
173. *T. parvula* Banks
174. *T. contorta*, new species

Subgenus Rhabdiopteryx Klapalek

175. *T. fasciata* Burmeister
frigida Hagen

Subgenus Taeniopteryx Pictet
Taenionema Banks

176. *T. nigripennis* Banks
177. *T. pacifica* Banks
analis Banks
178. *T. californica*, new species
179. *T. grinnelli* Banks
180. *T. banksii*, new name
pallida Banks (partim)
181. *T. pallida* Banks

Subgenus Doddsia (nov.)

182. *T. occidentalis* Banks

Family CAPNIIDAE

22. Genus Capnia Pictet
Arsapnia Banks

Subgenus Eucapnopsis Okamoto

183. *C. vernalis* Newport
tenuis Walker

Subgenus Capnia Pictet

184. *C. nana* Claassen
185. *C. glabra* Claassen
186. *C. gracilaria* Claassen
187. *C. grandis* Banks
188. *C. elongata* Claassen
189. *C. excavata* Claassen
190. *C. tumida* Claassen
191. *C. teresa* Claassen
192. *C. californica* Claassen
193. *C. fibula* Claassen

†See footnote on Eccoptura Klp. on page 194, *antica*.

194. *C. nearctica* Banks
195. *C. decepta* Banks
196. *C. columbiana* Claassen
197. *C. manitoba* Claassen
198. *C. barberi* Claassen
199. *C. bakeri* Banks
200. *C. brevicauda* Claassen
201. *C. crinita,* new species

23. Genus Capnura Banks
202. *C. venosa* Banks

24. Genus Capnella Claassen
203. *C. granulata* Claassen
204. *C. recta* Claassen
205. *C. incisura* Claassen
206. *C. vivipara* Claassen
207. *C. pygmaea* Burmeister

TABLE OF DISTRIBUTION BY STATES.

States	Pteronarcys	Pteronarcella	Perlodes	Isogenus	Perla	Alloperla	Chloroperla	Paraperla	Kathroperla	Neoperla	Clioperla	Isoperla	Perlesta	Atoperla	Perlinella	Peltoperla	Acroneuria	Nemoura	Leuctra	Perlomyia	Taeniopteryx	Capnia	Capnura	Capnella	Total
Ala.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Alaska	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	3
Ariz.	–	1	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	4
Ark.	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	2
Calif.	2	–	4	–	2	6	–	1	1	–	–	2	–	–	–	2	–	4	5	2	–	2	8	–	41
Colo.	1	–	1	2	4	7	–	1	–	–	2	–	–	–	–	–	3	6	2	–	4	2	–	–	35
Conn.	2	–	–	–	–	–	–	–	–	1	–	1	1	–	–	–	–	–	–	–	–	–	–	–	5
Del.	2	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	3
Fla.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ga.	1	–	–	–	1	3	1	–	–	–	–	1	1	–	–	2	1	2	2	–	–	–	–	–	15
Idaho	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Ill.	2	–	–	–	2	–	–	–	–	1	–	2	–	–	–	–	3	1	–	–	1	–	–	2	14
Ind.	–	–	–	–	3	–	–	–	–	–	1	2	1	–	1	–	2	–	–	–	–	–	–	–	10
Iowa	2	–	–	–	–	–	–	–	–	1	–	1	–	–	–	1	1	–	–	–	–	–	–	–	6
Kan.	2	–	–	–	3	–	–	–	–	1	–	1	–	–	–	–	3	–	–	–	1	–	–	–	11
Ky.	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
La.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Me.	2	–	–	–	2	3	1	–	–	1	–	2	–	–	1	–	2	5	1	–	2	–	–	2	24
Md.	–	–	–	–	2	–	1	–	–	1	1	–	1	–	–	–	4	–	–	–	3	–	–	3	16
Mass.	3	–	–	–	2	2	–	–	–	–	–	1	1	1	–	1	2	3	1	–	4	–	–	2	23
Mich.	2	–	–	–	3	–	–	–	–	1	–	1	1	–	–	–	2	–	–	–	–	1	–	–	11
Minn.	2	–	–	–	2	–	–	–	–	1	–	2	1	–	–	–	1	–	–	–	2	–	–	–	11
Miss.	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Mo.	2	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	1	–	–	1	7
Mont.	1	1	1	1	1	3	–	1	–	–	1	–	–	–	–	–	4	1	–	–	–	1	–	–	16
Nebr.	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
Nev.	–	1	–	–	1	2	1	–	–	–	1	–	–	–	–	2	–	1	1	–	–	–	–	–	10
N. H.	2	–	1	–	3	1	1	–	–	1	2	2	–	–	1	–	1	2	–	–	2	–	–	1	20
N. J.	2	–	–	–	1	–	–	–	–	–	–	2	1	–	1	–	1	–	–	–	1	–	–	–	9
N. M.	–	–	–	–	2	2	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	7
N. Y.	5	–	1	1	6	5	–	–	–	1	2	3	1	1	–	2	5	7	7	–	3	1	–	5	56
N. C.	2	–	–	–	8	3	1	–	–	–	1	1	1	1	2	1	5	4	3	–	2	–	–	–	35
N. D.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ohio	2	–	–	–	–	–	–	–	–	1	–	2	–	–	–	3	–	–	–	–	–	–	–	1	9
Okla.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ore.	2	2	–	1	3	1	–	–	–	–	1	–	–	–	–	1	2	2	–	–	1	–	–	–	16
Penn.	2	–	–	–	2	–	1	–	–	1	1	1	–	–	–	1	5	1	1	–	2	–	–	1	19
R. I.	2	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	3
S. C.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
S. D.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tenn.	2	–	–	–	1	–	–	–	–	1	–	–	1	–	1	–	3	–	–	–	1	–	–	–	10
Tex.	–	–	–	–	1	–	–	–	–	1	–	–	1	–	–	–	2	–	–	–	–	–	–	–	5
Utah	1	1	1	1	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	1	1	–	–	–	8
Vt.	3	–	–	–	–	1	–	–	–	1	–	1	1	–	–	–	–	–	–	–	–	–	–	–	7
Va.	1	–	–	–	2	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	2	–	–	1	8
Wash.	2	1	3	1	1	4	–	–	–	2	1	–	–	–	–	1	3	4	2	–	4	–	1	–	30
W. Va.	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	3	–	–	–	1	–	–	–	7
Wis.	1	–	–	2	1	1	1	–	–	–	–	1	1	–	–	–	2	–	–	–	1	–	–	–	11
Wyo.	1	1	–	–	2	2	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	9
D. C.	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	–	–	2	–	2	–	11
Provinces of Canada																									
Alberta	–	1	1	1	–	3	–	–	–	–	1	2	–	–	–	–	2	2	1	–	1	–	–	–	15
B. C.	1	1	3	1	–	6	–	–	1	–	1	–	–	–	1	–	–	4	2	1	2	3	–	–	27
Man.	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	1	–	–	–	2·	–	–	6
N. B.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. Sc.	–	–	–	–	1	3	1	–	–	1	–	1	–	–	–	–	–	–	–	1	–	–	1	–	8
Ont.	2	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	1	1	–	–	–	1	–	–	7
Pr. Ed. Is.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Que.	–	–	–	1	2	–	–	–	–	1	–	1	–	–	–	–	2	1	–	–	–	–	–	–	8
Sask.	–	–	–	1	1	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	3
Yukon	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
N. F.	–	–	–	1	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	4

PLATES AND EXPLANATIONS

FINDING LIST FOR THE PLATE FIGURES.

	Genera		Wings	Genitalia	Eggs	Misc.
17	Acroneuria	Plates	2, 15, 16	4, 19, 28, 29	6, 30	1* 3† ‡ §
6	Alloperla	"	2, 14	20, 21. 22		
14	Atoperla	"	2, 15	24	24	
24	Capnella	"	2, 47	50	6	
22	Capnia	"	2, 33, 47	48, 49		
23	Capnura	"	47	49		
7	Chloroperla	"	2, 14	23		
11	Clioperla	"	11, 12, 13	25		
4	Isogenus	"	2, 11	10	5	1* 3¶
12	Isoperla	"	2, 14	25, 26, 27	5	1*
9	Kathroperla	"	2, 15	23		1*
19	Leuctra	"	2, 32	40, 41, 42, 43		
18	Nemoura	"	2, 32	34-39		
10	Neoperla	"	2	24	6, 24	
8	Paraperla	"	2, 15	23	23	
16	Peltoperla	"	2, 15	31	5	
5	Perla	"	2, 11–14	17, 18, 19, 25	5, 6, 17–19	1* 3¶
13	Perlesta	"	2, 15	24	24	
15	Perlinella	"	2	24	5	1*
3	Perlodes	"	2, 9	4, 7, 9, 10	6	1*
20	Perlomyia	"	32	43		
2	Pteronarcella	"	2	7, 8	5, 8	
1	Pteronarcys	"	2	7	5	
21	Taeniopteryx	"	2, 33	44, 45, 46		3†

*Head and prothorax
†Mouthparts
‡Foot
§Antennae
¶Tails

The order of treatment in the text is shown by the figures in the left hand column.

PLATE 1.

Head and Prothorax of Plecoptera.

Fig. 1. *Acroneuria pacifica* Bks.
Fig. 2. *Acroneuria ruralis* Hag.
Fig. 3. *Acroneuria abnormis* Newm.
Fig. 4. *Isogenus frontalis* Newm.
Fig. 5. *Acroneuria lycorias* Newm.
Fig. 6. *Isoperla montana* Bks.
Fig. 7. *Perlodes tibialis* Bks.
Fig. 8. *Acroneuria carolinensis* Bks.
Fig. 9. *Perla immarginata* Say
Fig. 10. *Perlinella drymo* Newm.
Fig. 11. *Kathroperla perdita* Bks.
Fig. 12. *Perla luctuosa* Bks.

PLATE 1.

PLATE 2.

Wings of Plecoptera.

Fig. 1. Pteronarcys.
Fig. 2. Pteronarcella.
Fig. 3. Perlodes.
Fig. 4. Acroneuria.
Fig. 5. Isogenus.
Fig. 6. Kathroperla.
Fig. 7. Perla.
Fig. 8. Perlesta.
Fig. 9. Peltoperla.
Fig. 10. Perlinella.
Fig. 11. Atoperla.
Fig. 12. Neoperla.
Fig. 13. Paraperla.
Fig. 14. Isoperla.
Fig. 15. Alloperla.
Fig. 16. Chloroperla.
Fig. 17. Nemoura.
Fig. 18. Taeniopteryx.
Fig. 19. Capnella.
Fig. 20. Capnia.
Fig. 21. Leuctra.

PLATE 2.

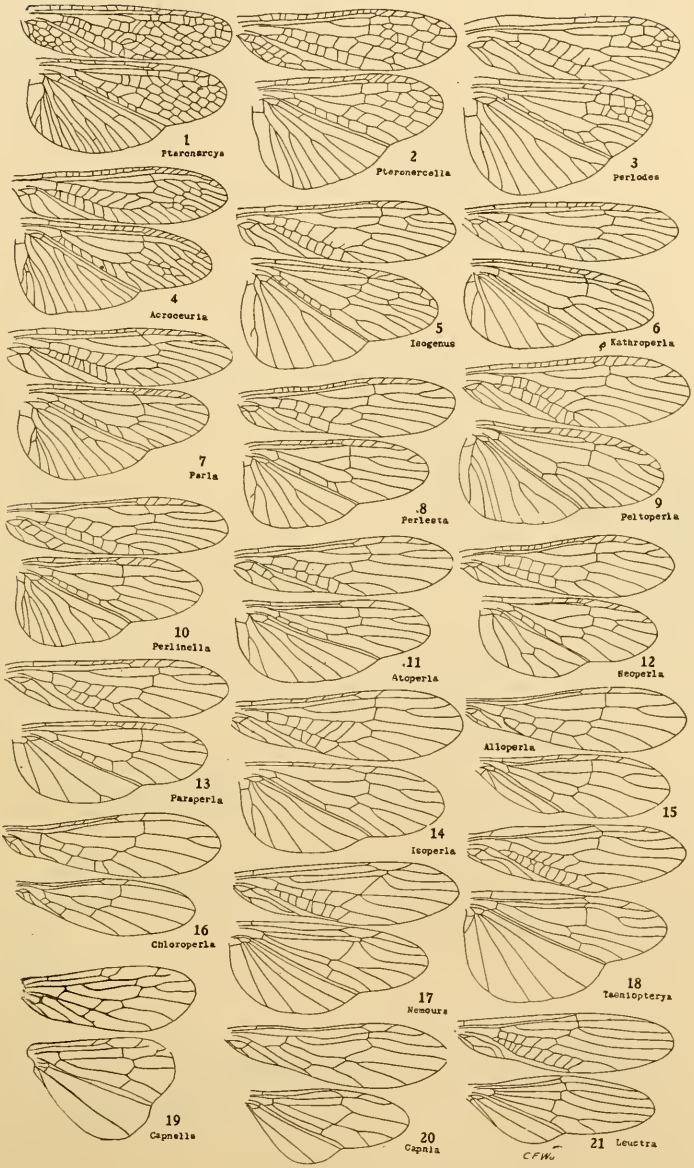

1
Pteronarcys
2
Pteronarcella
3
Perlodes
4
Acroneuria
5
Isogenus
6
♀ Kathroperla
7
Perla
8
Perlesta
9
Peltoperla
10
Perlinella
11
Atoperla
12
Neoperla
13
Paraperla
Alloperla
14
Isoperla
15
16
Chloroperla
17
Nemoura
18
Taeniopteryx
19
Capnella
20
Capnia
21 Leuctra
CFW.

PLATE 3.

Appendages of Plecoptera.

Fig. 1. *Acroneuria pacifica* Bks., maxilla.
Fig. 2. *Acroneuria pacifica* Bks., labium.
Fig. 3. *Acroneuria pacifica* Bks., mandible.
Fig. 4. *Acroneuria pacifica* Bks., antenna.
Fig. 5. *Acroneuria pacifica* Bks., middle leg.
Fig. 6. *Acroneuria pacifica* Bks., front foot.
Fig. 7. *Taeniopteryx ruralis* Fitch, mandible.
Fig. 8. *Taeniopteryx ruralis* Fitch, maxillary palpus.
Fig. 9. *Perla phalerata* Smith, portion of tail.
Fig. 10. *Isogenus colubrinus* Hag., portion of tail.
Fig. 11. *Perla ramosa* sp. nov., portion of tail.

Drawings by Miss Theresa M. Robinson.

PLATE 3.

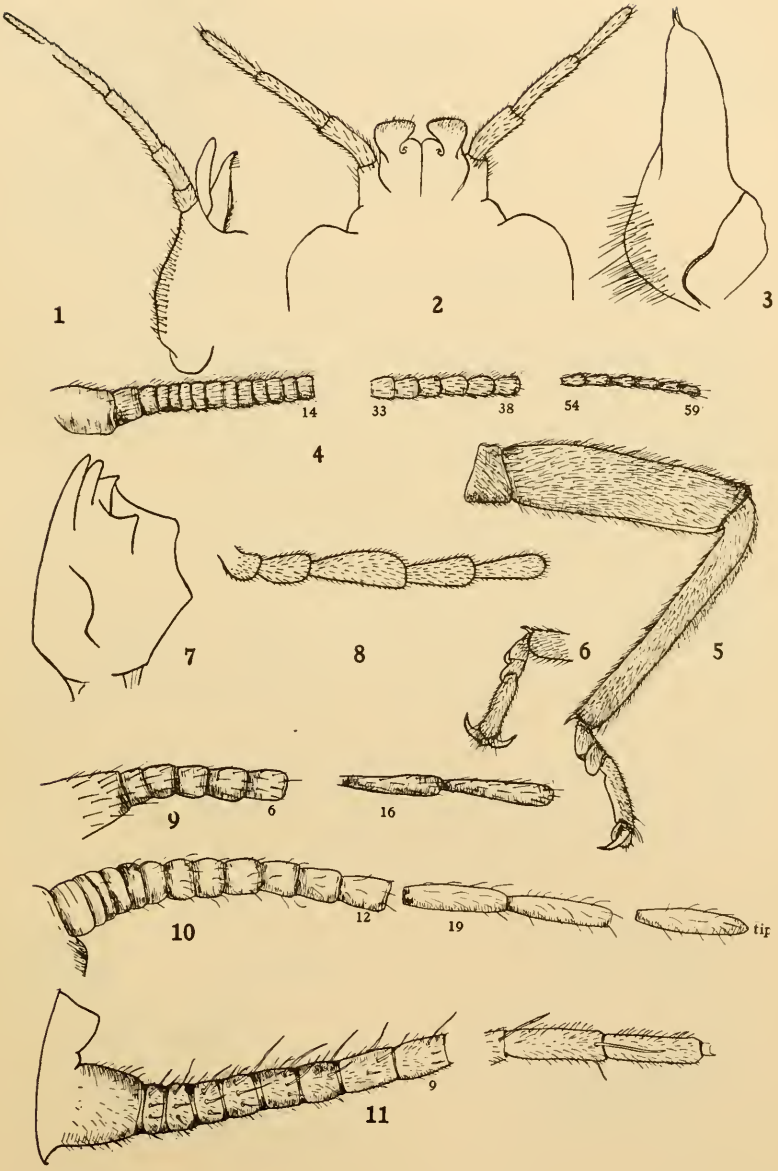


PLATE 4.

Genitalia of Plecoptera.

Fig. 1. *Acroneuria arenosa* Pict., end of abdomen of ♂, dorsal view.
Fig. 2. *Acroneuria arenosa* Pict., end of abdomen of ♂, ventral view.
Fig. 3. *Acroneuria arenosa* Pict., end of abdomen of ♂, lateral view.
Fig. 4. *Acroneuria arenosa* Pict., end of abdomen of ♀, ventral view: *gh*, genital hooks; *h*, hammer; *e*, eggs.
Fig. 5. *Acroneuria arenosa* Pict., a genital hook removed, and enlarged.
Fig. 6. *Perlodes signata* Hag., end of abdomen of ♂, lateral view, with supra-anal process (*s*) elevated and penis protruded; the segments are numbered 7, 8, 9 and 10; *t*, tail; *l. s.* lateral stylet of the supra-anal process; *tl.* titillator of the penis.
Fig. 7. The detached 9th segment of the same.
Fig. 8. The detached 10th segment of the same.
Fig. 9. The detached supra-anal process of the same. *b*, the basal mid-dorsal attachment plate; *ls*, lateral stylet; *m*, membranous flap.
Fig. 10. The detached subanal plate (*sub. a*) bearing the tail (*t.*).
Fig. 11. *Acroneuria pacifica* Bks., end of abdomen, lateral view.
Fig. 12. *Acroneuria pacifica* Bks., with penis protruded.

The Acroneuria drawings are by Miss M. J. Fisher.
The Perlodes drawings are by Miss Hazel E. Branch.

PLATE 4.

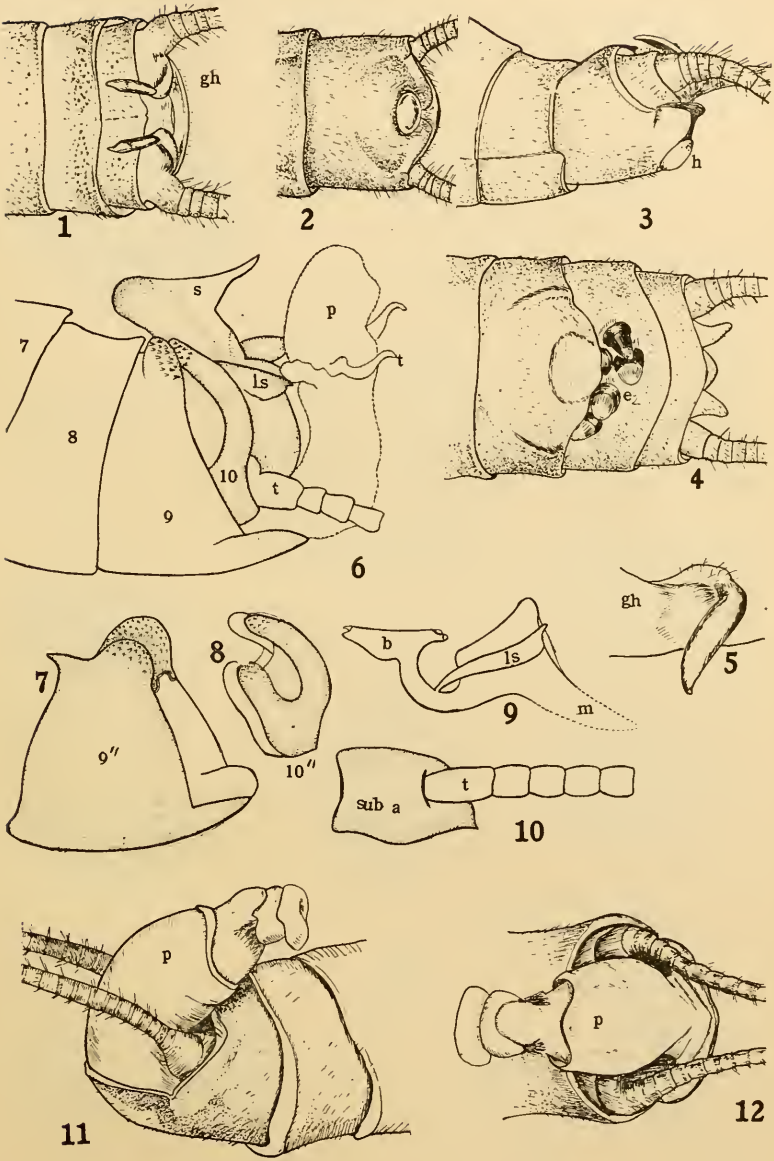


PLATE 5.

Eggs of Plecoptera.

Fig. 1. *Pteronarcys dorsata* Say, lateral view.
Fig. 2. *Pteronarcys dorsata* Say, lateral view.
Fig. 3. *Pteronarcys dorsata* Say, cap.
Fig. 4. *Pteronarcys dorsata* Say, top view.
Fig. 5. *Peltoperla arcuata* Ndm., lateral view.
Fig. 6. *Peltoperla arcuata* Ndm., minute structure, a detail of the surface.
Fig. 7. *Isogenus colubrinus* Hag.
Fig. 8. *Isogenus frontalis* Newm.
Fig. 9. *Perla expansa* Bks.
Fig. 10. *Pteronarcella regularis* Hag., lateral view.
Fig. 11. *Pteronarcella regularis* Hag., cap from under side.
Fig. 12. *Isoperla bilineata* Say, lateral view.
Fig. 13. *Isoperla bilineata* Say, minute structure, a detail of the surface.
Fig. 14. *Perlinella drymo* Newm., lateral view.
Fig. 15. *Perlinella drymo* Newm., lateral view of cap.
Fig. 16. *Perlinella drymo* Newm., top view of cap.

Drawings by Miss Theresa McConnell.

PLATE 5.

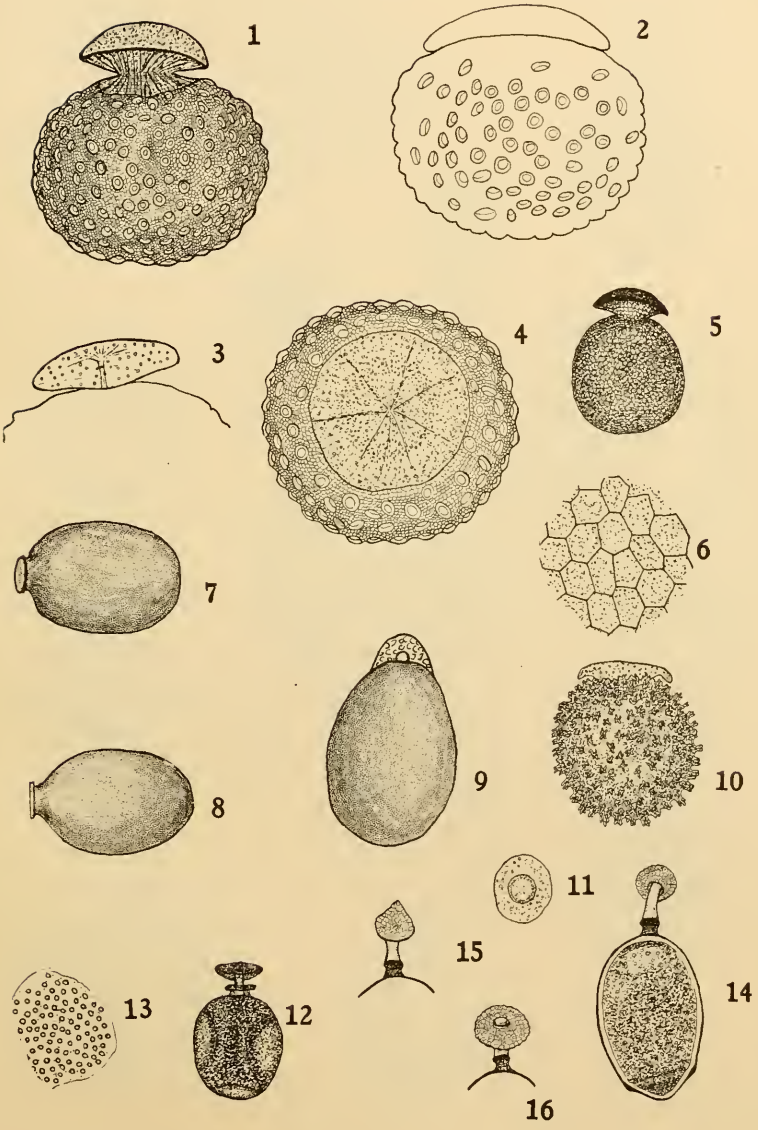


PLATE 6.

Eggs of Plecoptera.

Fig. 1. *Perla media* Walk., lateral view of egg.
Fig. 2. *Perla media* Walk., lateral view of egg, cap extended.
Fig. 3. *Perla media* Walk., a detail of the surface of same.
Fig. 4. *Perla* sp.? (Los Angeles, Calif.).
Fig. 5. *Perla* sp.? Another view.
Fig. 6. *Acroneuria lycorias* Newm., lateral view of egg.
Fig. 7. *Acroneuria lycorias* Newm., lateral view of egg, with cap everted.
Fig. 8. *Perlodes* sp.? (Wyoming).
Fig. 9. *Capnella vivipara* Clsn., soft-shelled egg from ovary, containing embryo.
Fig. 10. *Anacroneuria* sp.? (from Argentina).
Fig. 11. *Neoperla clymene* Newm., lateral view of egg.
Fig. 12. *Neoperla* sp.? detail of lower end of same.
Fig. 13. *Perla varians* Walsh, lateral view of egg.
Fig. 14. *Perla varians* Walsh, diagram of cross-section of same.

Drawings by Miss Theresa McConnell.

PLATE 6.

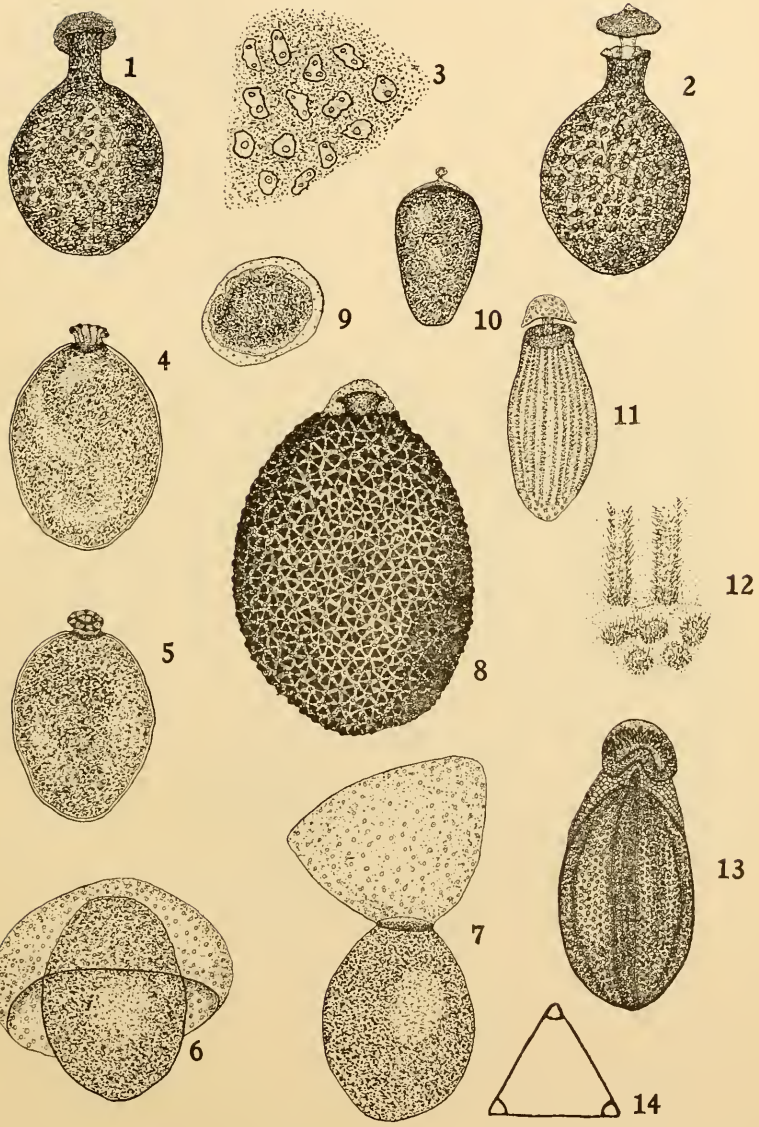


PLATE 7.

Genitalia of Pteronarcys, Pteronarcella and Perlodes.

Fig. 1. *Pteronarcys dorsata* Say ♂, side view.
Fig. 2. *Pteronarcys dorsata* Say ♀, ventral view.
Fig. 3. *Pteronarcys nobilis* Hag. ♂, side view.
Fig. 4. *Pteronarcys nobilis* Hag. ♀, ventral view.
Fig. 5. *Pteronarcys californica* Newp. ♂, side view.
Fig. 6. *Pteronarcys californica* Newp. ♀, ventral view.
Fig. 7. *Pteronarcys princeps* Bks. ♂, side view.
Fig. 8. *Pteronarcys princeps* Bks. ♀, ventral view.
Fig. 9. *Pteronarcys biloba* Newm. ♂, side view.
Fig. 10. *Pteronarcys biloba* Newm. ♀, ventral view.
Fig. 11. *Pteronarcys proteus* Newm. ♂, side view.
Fig. 12. *Pteronarcys proteus* Newm. ♀, ventral view.
Fig. 13. *Pteronarcys comstocki* Smith ♀, ventral view.
Fig. 14. *Pteronarcella badia* Hag. ♂, dorsal view.
Fig. 15. *Pteronarcella regularis* Hag., ♂, dorsal view.
Fig. 16. *Pteronarcella badia* Hag. ♀, ventral view.
Fig. 17. *Pteronarcella badia* ♀, ventral view.
Fig. 18. *Perlodes lincata* Smith ♀, ventral view.
Fig. 19. *Perlodes slossonae* Bks. ♀, ventral view.
Fig. 20. *Perlodes yosemite* sp. nov. ♀, ventral view.
Fig. 21. *Perlodes americana* Klap. ♀, ventral view.
Fig. 22. *Perlodes ignota* Smith ♀, ventral view.
Fig. 23. *Perlodes aurea* Smith ♀, ventral view.
Fig. 24. *Perlodes irregularis* Bks. ♀, ventral view.

All except figs. 20 and 24, after Lucy W. Smith.

PLATE 7.

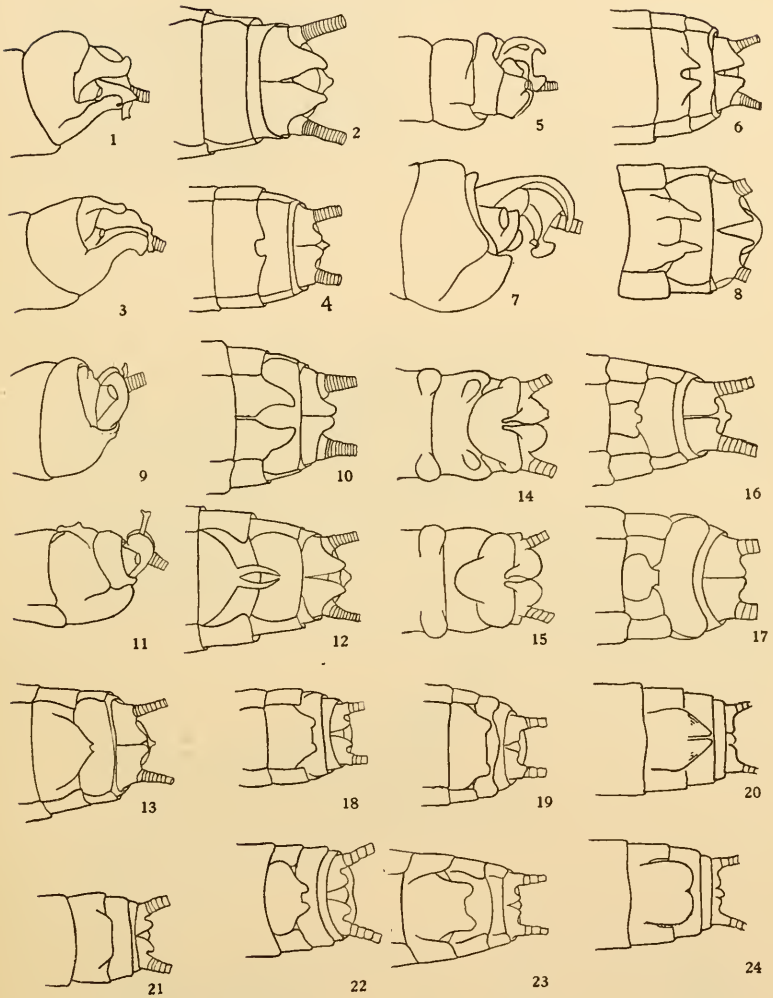
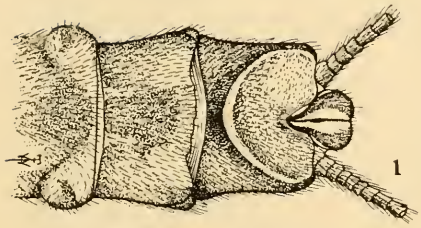


PLATE 8.

Genitalia of Pteronarcella.

Fig. 1. *Pteronarcella badia* Hag. ♂, dorsal view, normal position.
Fig. 2. *Pteronarcella badia* Hag. ♂, some of the internal genitalia exposed.
Fig. 3. *Pterornarcella regularis* Hag. ♂, some of the internal genitalia posed.
Fig. 4. *Pteronarcella regularis* Hag. ♂, dorsal view, normal position.
Fig. 5. *Pteronarcella regularis* Hag. ♀, ventral view.
Fig. 6. *Pteronarcella badia* Hag. ♀, ventral view.
Fig. 7. *Pteronarcella badia* Hag. egg.

PLATE 8.



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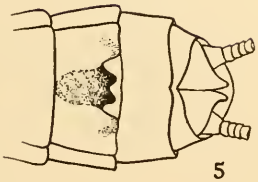

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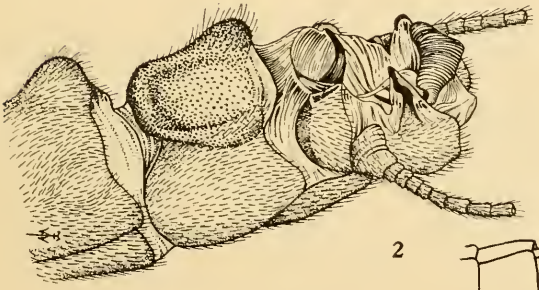

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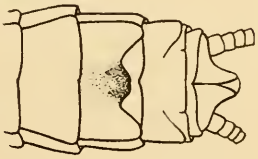

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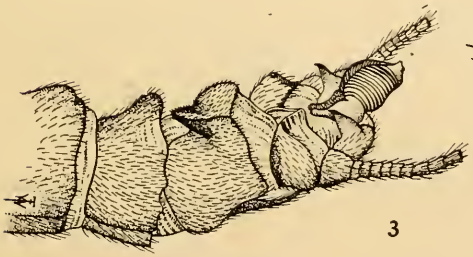

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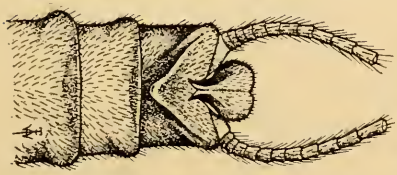

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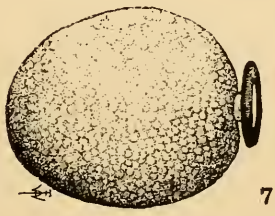


7

PLATE 9.

Wings and Genitalia of Perlodes.

Fig. 1. *Perlodes dolobrata* Smith ♀.
Fig. 2. *Perlodes vagans* Smith ♂.
Fig. 3. *Perlodes signata* Hag. ♀.
Fig. 4. *Perlodes bradleyi* Smith.
Fig. 5. *Perlodes bradleyi* Smith ♀, ventral view.
Fig. 6. *Perlodes dolobrata* Smith ♀, ventral view.
Fig. 7. *Perlodes signata* Hag. ♂, dorsal view.
Fig. 8. *Perlodes signata* Hag. ♀, ventral view.
After Lucy W. Smith.

PLATE 9.

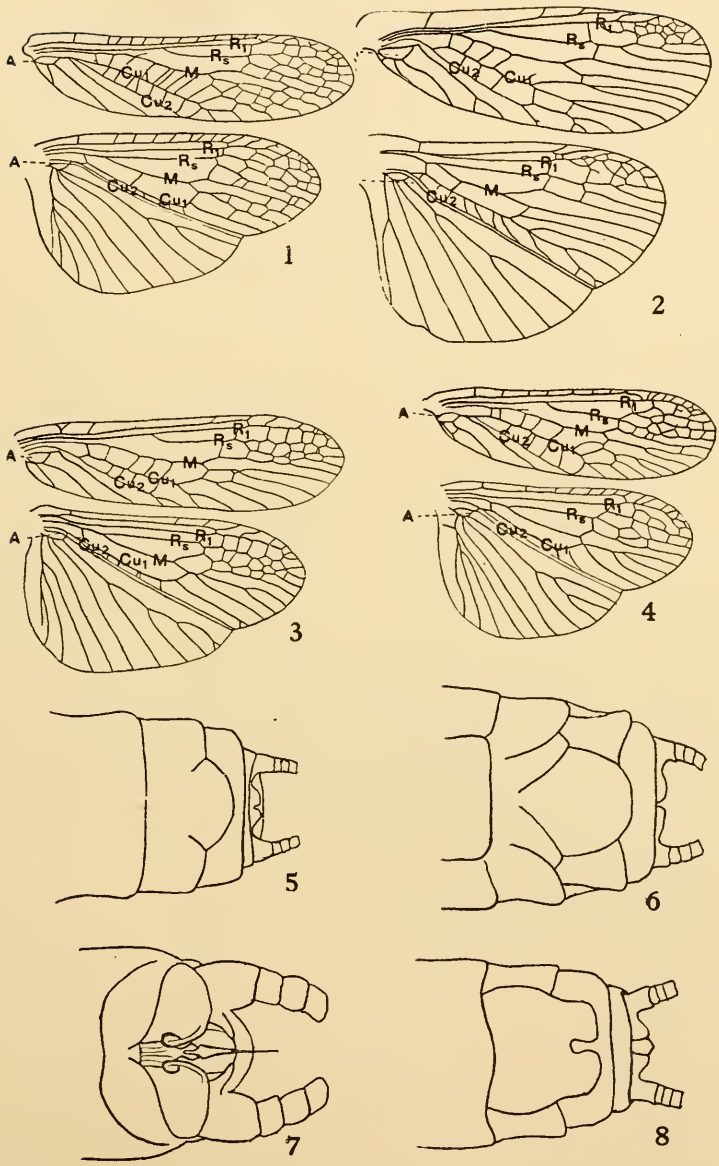


PLATE 10.

Genitalia of Perlodes and Isogenus.

Fig. 1. *Perlodes signata* Hag. ♂, dorsal view.
Fig. 2. *Perlodes vagans* Smith. ♂ side view.
Fig. 3. *Perlodes signata* Hag. ♂, dorsal view.
Fig. 4. *Perlodes bradleyi* Smith. ♂ genital hook on tenth abdominal tergite.
Fig. 5. *Perlodes americana* Klap. ♂ genital hook on tenth abdominal tergite.
Fig. 6. *Perlodes signata* Hag. ♂ genital hook on tenth abdominal tergite.
Fig. 7. *Perlodes irregularis* Bks. ♂ genital hook on tenth abdominal tergite.
Fig. 8. *Perlodes yosemite* sp. nov. ♂ genital hook on tenth abdominal tergite.
Fig. 9. *Perlodes vagans* Smith. ♂ genital hook on tenth abdominal tergite.
Fig. 10. *Isogenus frontalis* Newm. ♀, ventral view.
Fig. 11. *Isogenus colubrinus* Hag. ♀, ventral view.
Fig. 12. *Isogenus elongatus* Hag. ♀, ventral view.
Fig. 13. *Isogenus frontalis* Newm. ♂, dorsal view, penis retracted.
Fig. 14. *Isogenus frontalis* Newm. ♂, dorsal view, penis extruded.
Fig. 15. *Isogenus frontalis* Newm. ♂, side view.
Fig. 16. *Isogenus frontalis* Newm. ♂ supra-anal process and lateral stylets.
Fig. 17. *Isogenus elongatus* Hag. ♂ supra-anal process and lateral stylets.
Fig. 18. *Isogenus colubrinus* Hag. ♂ supra-anal process and lateral stylets.

PLATE 10.

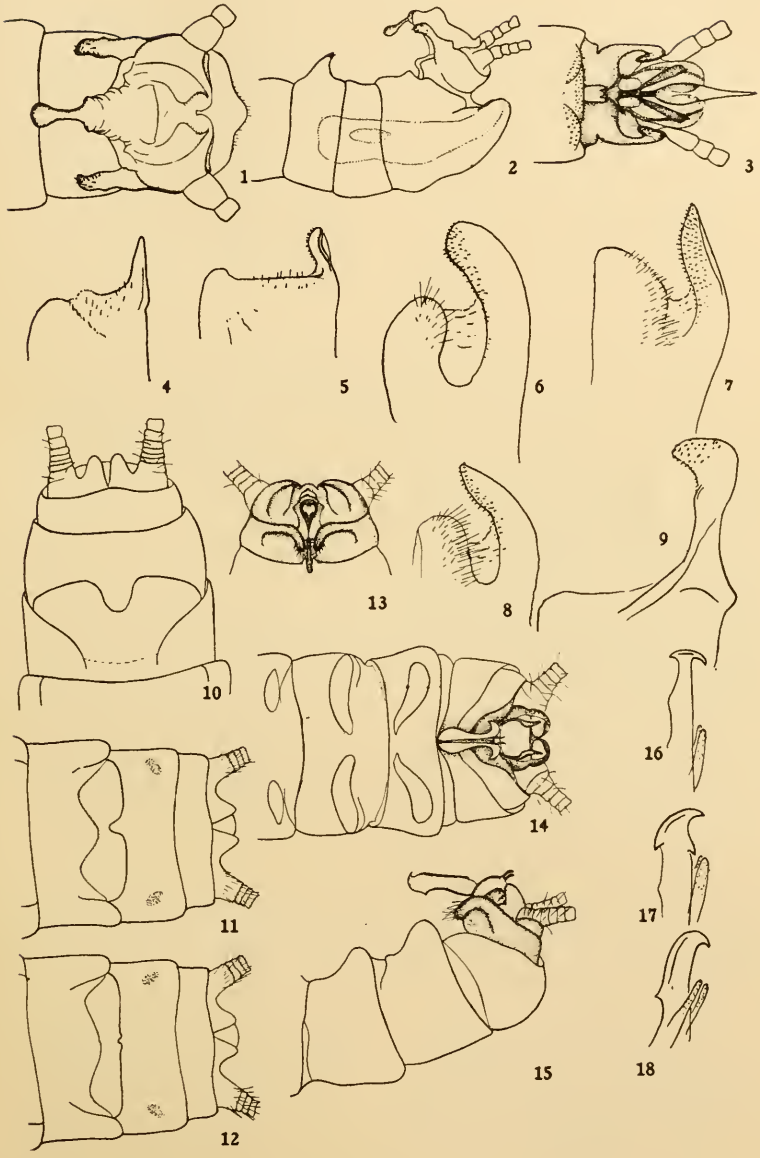


PLATE 11.

Wings of Isogenus, Perla and Clioperla.

Fig. 1. *Isogenus frontalis* Newm.
Fig. 2. *Perla hastata* Bks.
Fig. 3. *Perla postica* Walk.
Fig. 4. *Perla crosbyi* sp. nov.
Fig. 5. *Isogenus colubrinus* Hag.
Fig. 6. *Clioperla gravitans* sp. nov.
Fig. 7. *Perla expansa* Bks.
Fig. 8. *Perla venosa* sp. nov.

PLATE 11.

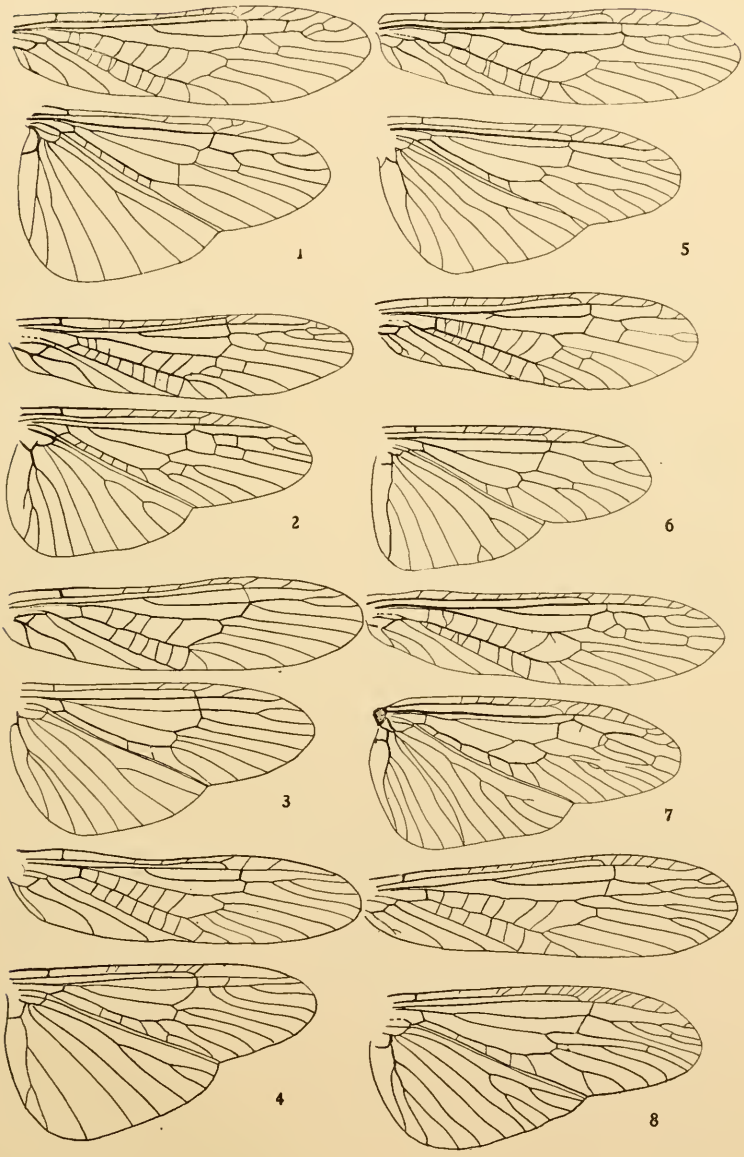


PLATE 12.

Wings of Perla and Clioperla.

Fig. 1. *Perla modesta* Bks.
Fig. 2. *Perla alameda* sp. nov.
Fig. 3. *Clioperla clio* Newm.
Fig. 4. *Perla sorpta* sp. nov.
Fig. 5. *Clioperla annecta* sp. nov.
Fig. 6. *Perla innubila* sp. nov.
Fig. 7. *Perla fugitans* sp. nov.
Fig. 8. *Perla luctuosa* Bks.

PLATE 12.

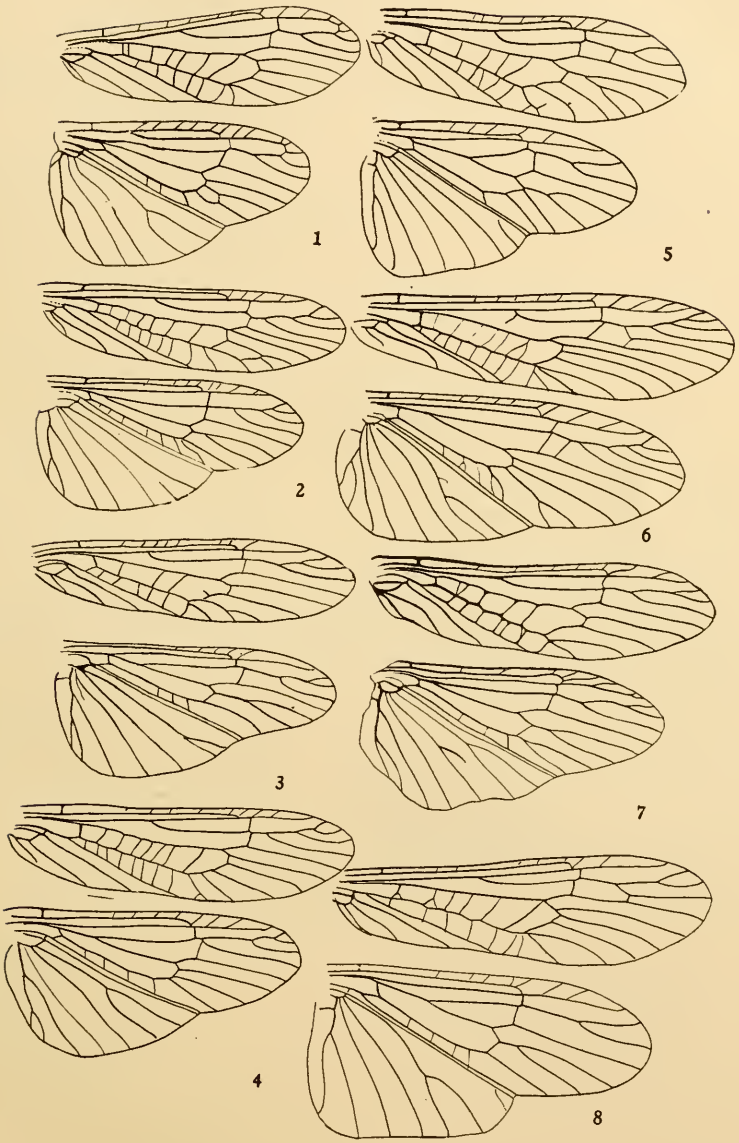


PLATE 13.

Wings of Perla.

Fig. 1. *Perla ramosa*, sp. nov.
Fig. 2. *Perla immarginata* Say
Fig. 3. *Perla media* Walk.
Fig. 4. *Perla sabulosa* Bks.
Fig. 5. *Perla languida* sp. nov. ♀
Fig. 6. *Clioperla marmorata* sp. nov.
Fig. 7. *Perla languida* sp. nov. brachypterous ♂.
Fig. 8. *Perla capitata* Pict.

PLATE 13.

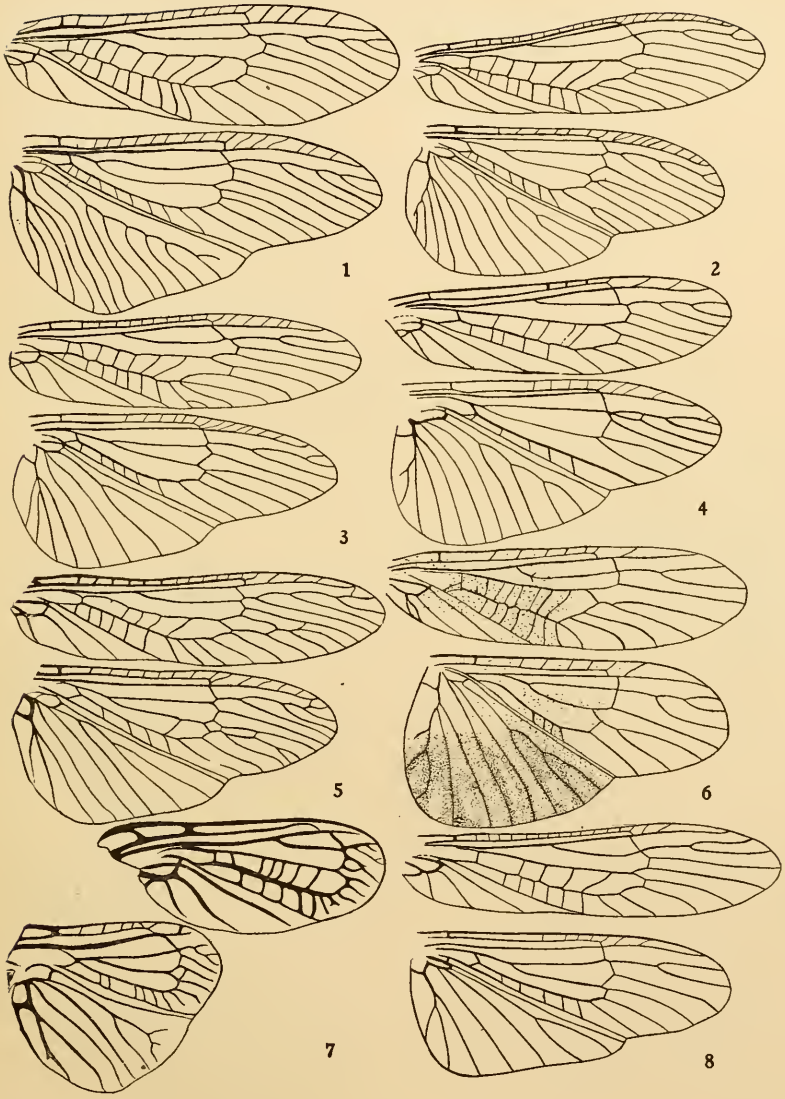


PLATE 14.

Wings of Perlidae.

Fig. 1. *Alloperla borealis* Bks.
Fig. 2. *Isoperla bilineata* Say.
Fig. 3. *Perla tincta* sp nov.
Fig. 4. *Alloperla lamba* sp. nov.
Fig. 5. *Perla aestivalis* sp. nov.
Fig. 6. *Chloroperla cydippe* Newm.
Fig. 7. *Perla bilobata* sp. nov.
Fig. 8. *Perla verticalis* Bks.

PLATE 14.

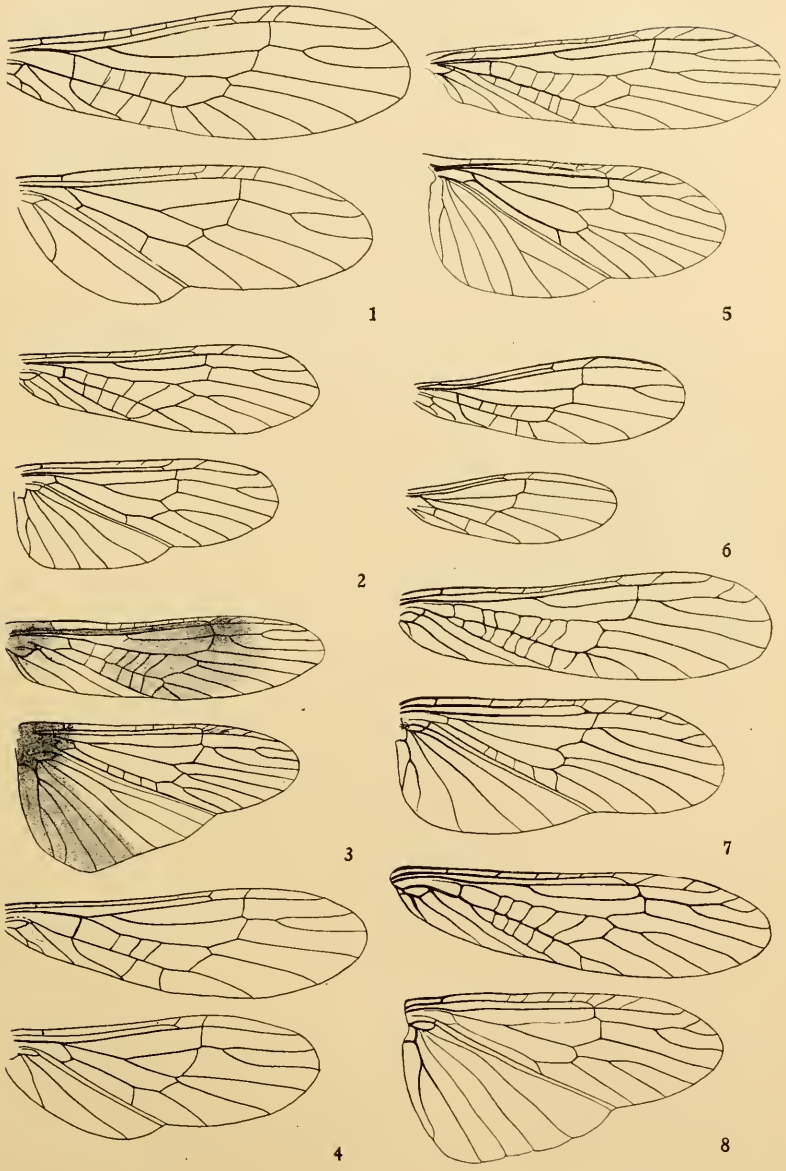


PLATE 15.

Wings of Perlidae.

Fig. 1. *Peltoperla brevis* Bks.
Fig. 2. *Peltoperla thyra* Ndm. & Sm.
Fig. 3. *Atoperla ephyre* Newm.
Fig. 4. *Aeroneuria georgiana* Bks.
Fig. 5. *Peltoperla anna* Ndm. & Sm.
Fig. 6. *Kathroperla perdita* Bks.
Fig. 7. *Perlesta placida* Hag.
Fig. 8. *Paraperla frontalis* Bks.

PLATE 15.

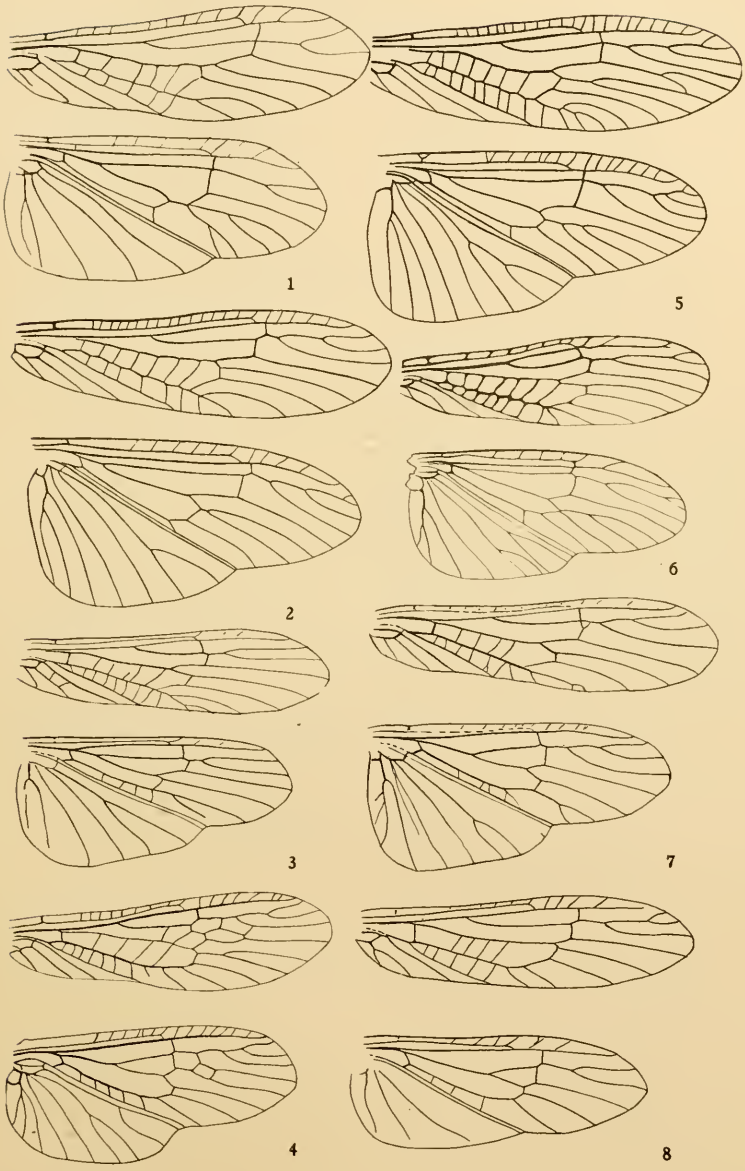


PLATE 16.

Wings of Acroneuria.

Fig. 1. *Acroneuria abnormis* Newm.
Fig. 2. *Acroneuria arenosa* Pict.
Fig. 3. *Acroneuria pacifica* Bks.
Fig. 4. *Acroneuria depressa* Ndm. & Clsn.
Fig. 5. *Acroneuria arida* Hag.
Fig. 6. *Acroneuria internata* Walk.
Fig. 7. *Acroneuria ruralis* Hag.
Fig. 8. *Acroneuria pennsylvanica* Ramb.
Fig. 9. *Acroneuria theodora* Ndm. & Clsn.
Fig. 10. *Acroneuria xanthenes* Newm.

PLATE 16.

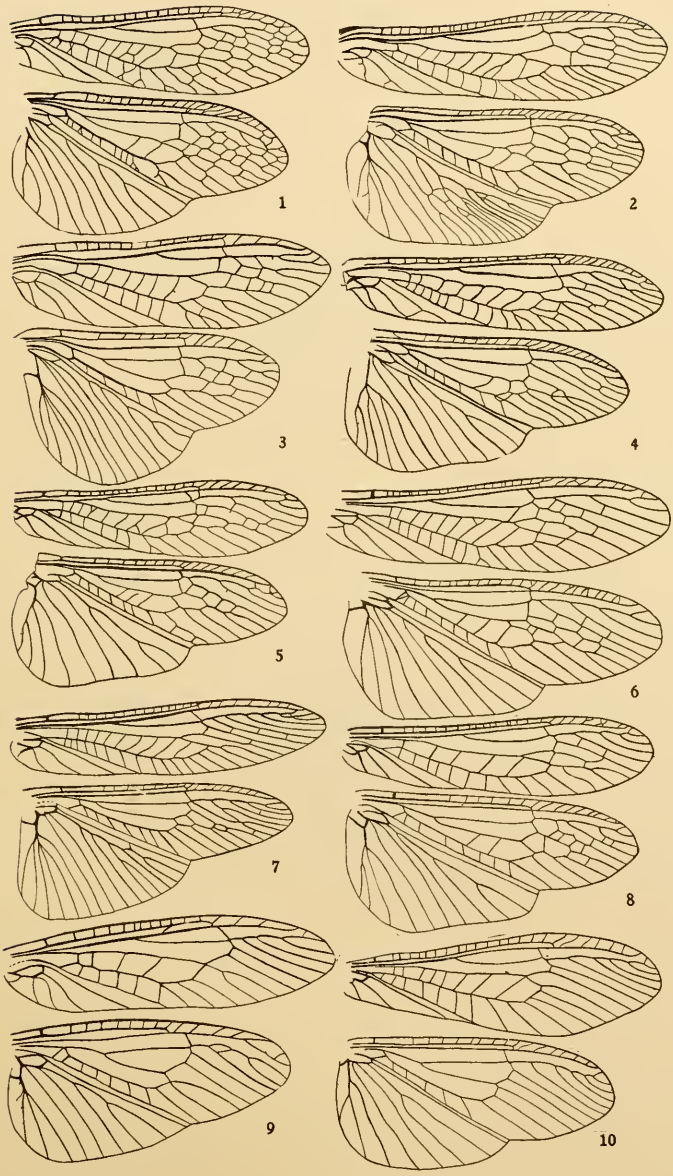


PLATE 17.

Genitalia of Perla

Fig. 1. *Perla hastata* Bks. ♂, dorsal view.
Fig. 2. *Perla hastata* Bks. ♂, side view, penis extruded.
Fig. 3. *Perla hastata* Bks. ♀, ventral view.
Fig. 4. *Perla expansa* Bks. ♀, ventral view.
Fig. 5. *Perla expansa* Bks. ♂, dorsal view.
Fig. 6. *Perla expansa* Bks. ♂, showing the 7th abdominal sternite.
Fig. 7. *Perla crosbyi* sp. nov. ♂, side view.
Fig. 8. *Perla crosbyi* sp. nov. ♂, dorsal view.
Fig. 9. *Perla phalerata* Smith ♀, ventral view.
Fig. 10. *Perla phalerata* Smith, egg.
Fig. 11. *Perla varians* Walsh ♀, ventral view.
Fig. 12. *Perla varians* Walsh ♂, dorsal view.
Fig. 13. *Perla fugitans* sp. nov. ♂, dorsal view.
Fig. 14. *Perla fugitans* sp. nov. ♂, supra-anal process.
Fig. 15. *Perla tincta* sp. nov. ♀, ventral view.
Fig. 16. *Perla modesta* Bks. ♀, ventral view.
Fig. 17. *Perla modesta* Bks. ♂, dorsal view.
Fig. 18. *Perla modesta* Bks. ♂, side view.
Fig. 19. *Perla modesta* Bks. ♂, showing the 7th abdominal sternite.
Fig. 20. *Perla innubila* sp. nov. ♀, ventral view.
Fig. 21. *Perla nona* sp. nov. ♀, ventral view.

PLATE 17.

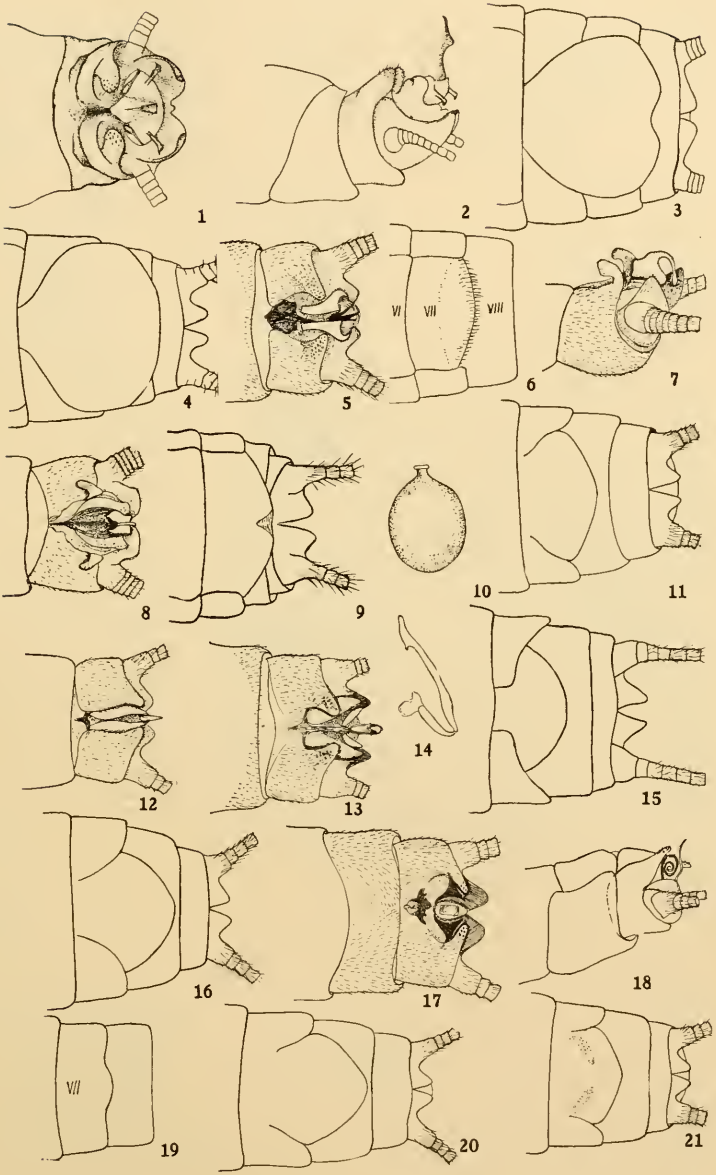


PLATE 18.

Genitalia of Perla.

Fig. 1. *Perla bilobata* sp. nov. ♂, ventral view.
Fig. 2. *Perla bilobata* sp. nov. ♀, ventral view.
Fig. 3. *Perla bilobata* sp. nov. ♂, side view.
Fig. 4. *Perla alameda* sp. nov. ♂, dorsal view.
Fig. 5. *Perla duplicata* Bks. ♂, dorsal view.
Fig. 6. *Perla duplicata* Bks. ♂, ventral view.
Fig. 7. *Perla aestivalis* sp. nov. ♀, ventral view.
Fig. 8. *Perla aestivalis* sp. nov. ♂, dorsal view.
Fig. 9. *Perla aestivalis* sp. nov. eggs.
Fig. 10. *Perla aestivalis* sp. nov. ♂, ventral side.
Fig. 11. *Perla venosa* sp. nov. ♂, ventral view.
Fig. 12. *Perla venosa* sp. nov. ♂, dorsal view.
Fig. 13. *Perla verticalis* Bks. ♂, dorsal view.
Fig. 14. *Perla verticalis* Bks. ♂, ventral view.
Fig. 15. *Perla verticalis* Bks. ♀, ventral view.
Fig. 16. *Perla luctuosa* Bks. ♂, ventral view.
Fig. 17. *Perla luctuosa* Bks. ♂, dorsal view.
Fig. 18. *Perla luctuosa* Bks. ♂, side view.
Fig. 19. *Perla luctuosa* Bks. ♀, ventral view.

PLATE 18.

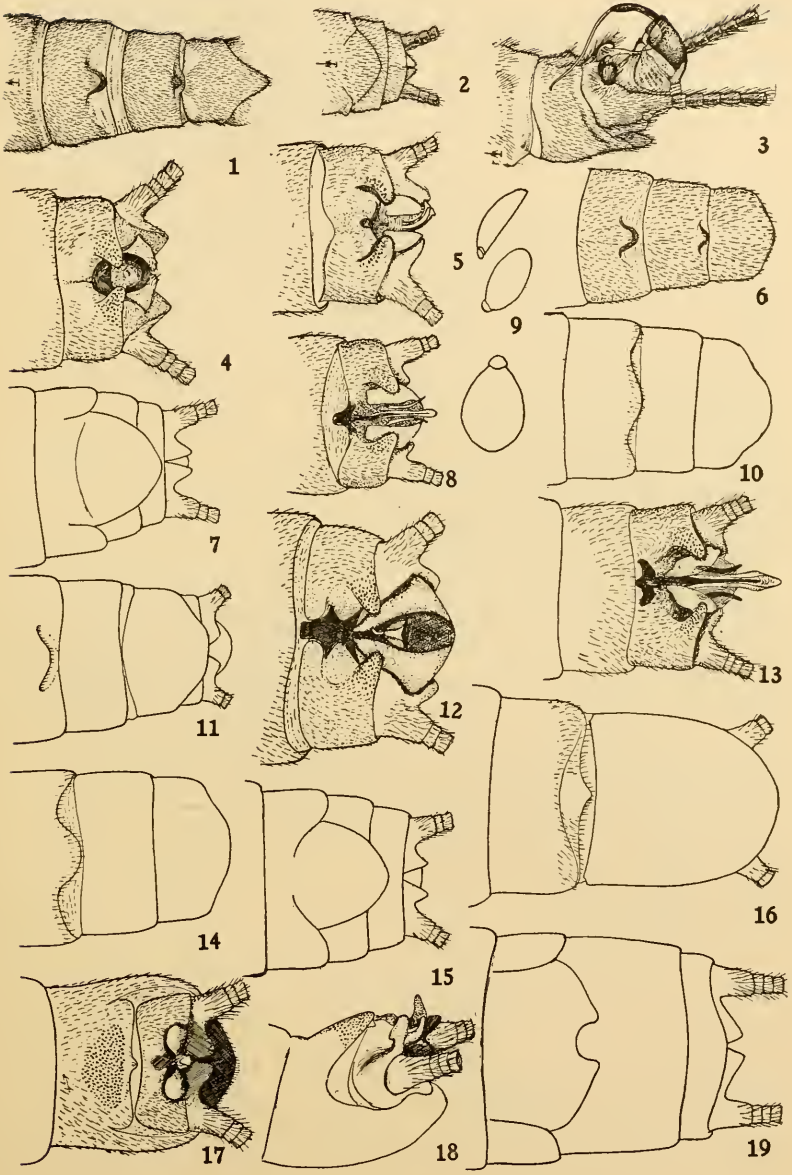


PLATE 19.

Genitalia of Perla and Acroneuria.

Fig. 1. *Perla capitata* Pict. ♂, dorsal view.
Fig. 2. *Perla capitata* Pict. ♂, side view.
Fig. 3. *Perla capitata* Pict. ♀, ventral view.
Fig. 4. *Perla media* Walk. ♂, dorsal view.
Fig. 5. *Perla media* Walk. ♀, ventral view.
Fig. 6. *Perla media* Walk. eggs.
Fig. 7. *Perla immarginata* Say ♀, ventral view.
Fig. 8. *Perla immarginata* Say ♂, dorsal view.
Fig. 9. *Perla immarginata* Say eggs.
Fig. 10. *Perla immarginata* ♂ genital hooks on tenth tergite.
Fig. 11. *Perla kansensis* Bks. ♂, dorsal view.
Fig. 12. *Perla kansensis* Bks. ♀, ventral view.
Fig. 13. *Acroneuria georgiana* Bks. ♂, ventral view.
Fig. 14. *Acroneuria georgiana* Bks. ♂, dorsal view.
Fig. 15. *Acroneuria georgiana* Bks. ♀, ventral view.
Fig. 16. *Acroneuria georgiana* Bks. ♀, variation in tip of subgenital plate.
Fig. 17. *Perla ramosa* sp. nov. ♀, ventral view.
Fig. 18. *Perla languida* sp. nov. ♂, ventral view.
Fig. 19. *Perla languida* sp. nov. ♂, dorsal view.
Fig. 20. *Perla languida* sp. nov. ♀, ventral view.

PLATE 19.

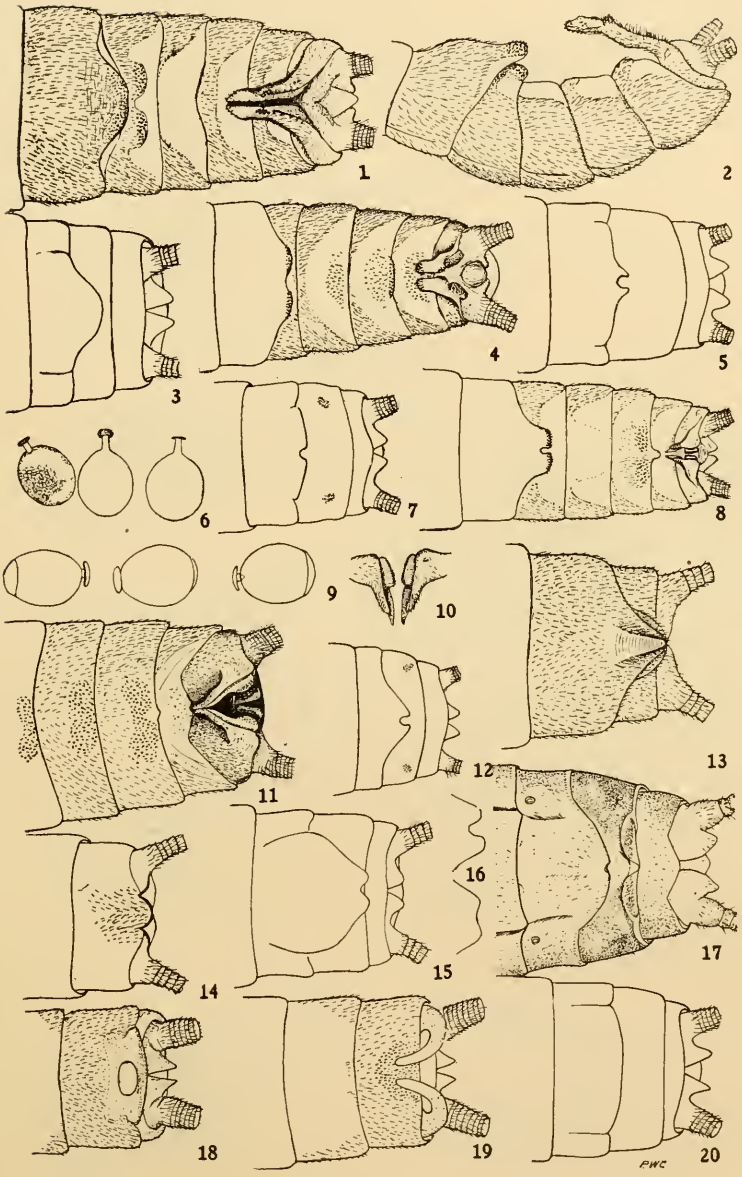


PLATE 20.

Genitalia of Alloperla.

Fig. 1. *Alloperla imbecilla* Say ♂.
Fig. 2. *Alloperla imbecilla* Say ♀, ventral view.
Fig. 3. *Alloperla nanina* Bks. ♂.
Fig. 4. *Alloperla nanina* Bks. ♀.
Fig. 5. *Alloperla signata* Bks. ♀.
Fig. 6. *Alloperla signata* Bks. ♂, penis extruded.
Fig. 7. *Alloperla pilosa* sp. nov. ♂.
Fig. 8. *Alloperla pilosa* sp. nov. ♂ supra-anal process fully extended.
Fig. 9. *Alloperla pilosa* sp. nov. ♀, ventral view.
Fig. 10. *Alloperla lineosa* Bks. ♂, dorsal view.
Fig. 11. *Alloperla lineosa* Bks. ♀, ventral view.
Fig. 12. *Alloperla serrata* sp. nov. ♂, dorsal view.
Fig. 13. *Alloperla serrata* sp. nov. ♀, ventral view.

PLATE 20.

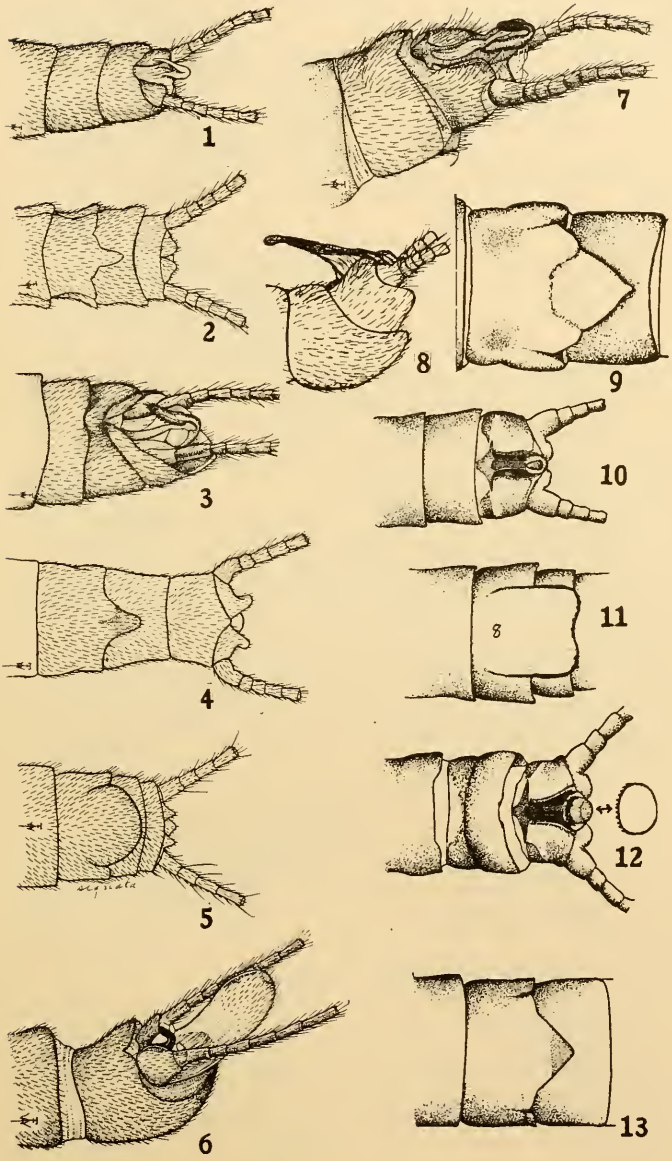


PLATE 21.

Genitalia of Alloperla.

Fig. 1. *Alloperla borealis* Bks. ♀, ventral view.
Fig. 2. *Alloperla borealis* Bks. ♂.
Fig. 3. *Alloperla borealis* Bks. ♂, dorsal view.
Fig. 4. *Alloperla mediana* Bks. ♀, ventral view.
Fig. 5. *Alloperla mediana* Bks. ♂.
Fig. 6. *Alloperla lateralis* Bks. ♂
Fig. 7. *Alloperla lateralis* Bks. ♀, ventral view.
Fig. 8. *Alloperla fidelis* Bks. ♂, dorsal view.
Fig. 9. *Alloperla fidelis* Bks. ♂, side view.
Fig. 10. *Alloperla fidelis* Bks. ♀, ventral view.
Fig. 11. *Alloperla continua* Bks. ♀, ventral view.
Fig. 12. *Alloperla continua* Bks. ♂, dorsal view.
Fig. 13. *Alloperla spatulata* sp. nov. ♀, ventral view.
Fig. 14. *Alloperla spatulata* sp. nov. ♂, dorsal view.

PLATE 21.

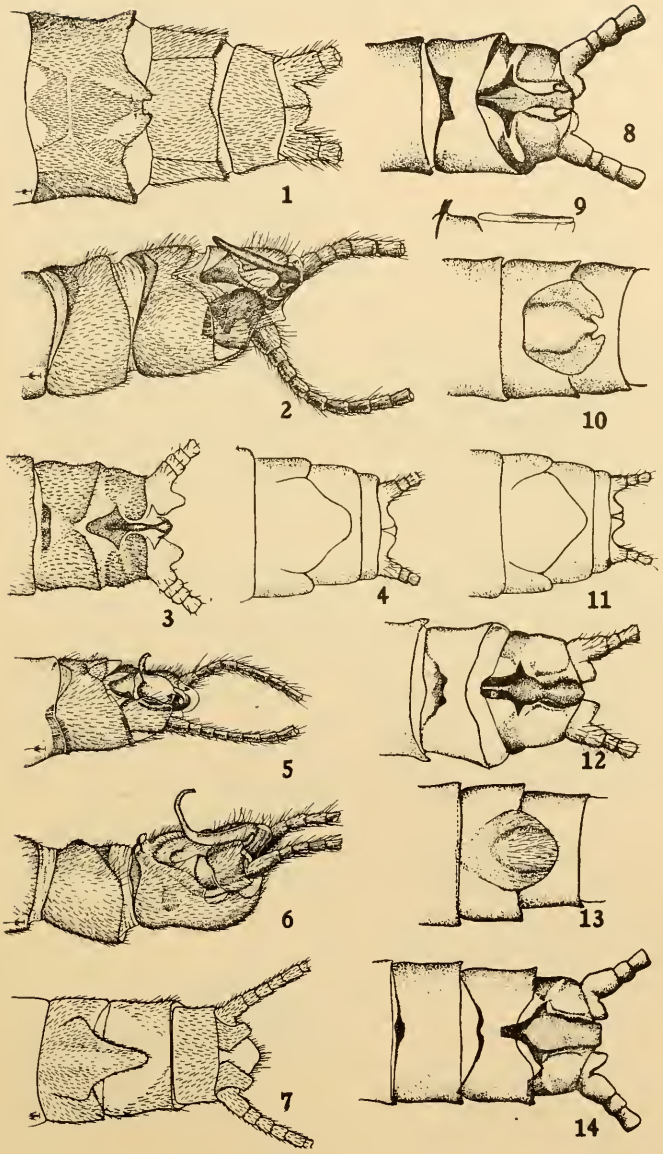


PLATE 22.

Genitalia of Alloperla.

Fig. 1. *Alloperla novascotiana* sp. nov. ♂, dorsal view.
Fig. 2. *Alloperla pacifica* Bks. ♂, dorso-lateral view.
Fig. 3. *Alloperla pacifica* Bks. ♀, ventral view.
Fig. 4. *Alloperla coloradensis* Bks. ♂, side view.
Fig. 4a. *Alloperla coloradensis* Bks. ♂, top view of supra-anal process.
Fig. 5. *Alloperla coloradensis* ♀, ventral view.
Fig. 6. *Alloperla albertensis* sp. nov. ♂.
Fig. 7. *Alloperla albertensis* sp. nov. ♀, ventral view.
Fig. 8. *Alloperla lamba* sp. nov. ♀, ventral view.
Fig. 9. *Alloperla lamba* sp. nov. ♂.
Fig. 10. *Alloperla marginata* Bks. ♂.
Fig. 11. *Alloperla marginata* Bks. ♀, ventral view.
Fig. 12. *Alloperla pallidula* Bks. ♂, dorsal view.
Fig. 13. *Alloperla pallidula* Bks. ♀, ventral view.

PLATE 22.

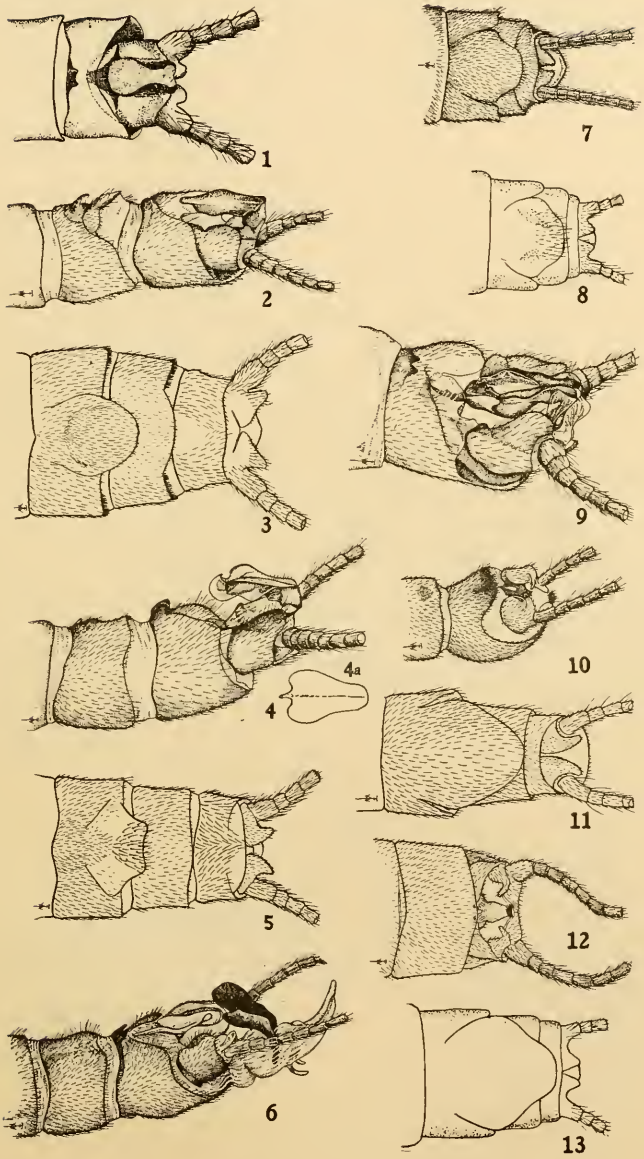
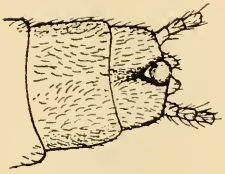


PLATE 23.

Genitalia of Chloroperla, Paraperla, Kathroperla.

Fig. 1. *Chloroperla cydippe* Newm. ♂, dorsal view.
Fig. 2. *Chloroperla cydippe* Newm. ♂, side view.
Fig. 3. *Chloroperla cydippe* Newm. ♀, ventral view.
Fig. 4. *Paraperla frontalis* Bks. ♂, side view.
Fig. 5. *Paraperla frontalis* Bks. eggs.
Fig. 6. *Paraperla frontalis* Bks. ♂, ventral view.
Fig. 7. *Kathroperla perdita* Bks. ♂, side view.
Fig. 8. *Kathroperla perdita* Bks. ♀, ventral view.

PLATE 23.



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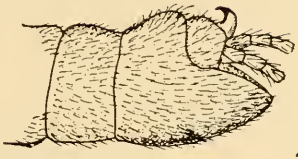

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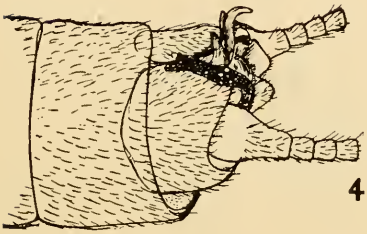

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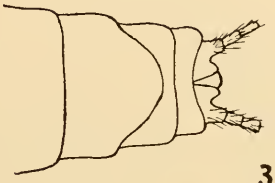

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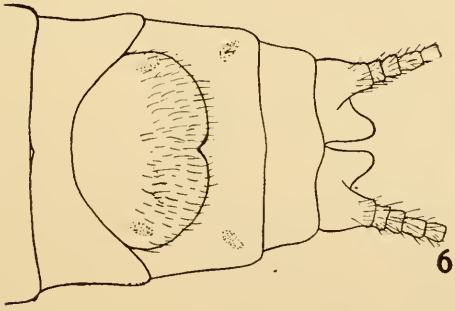

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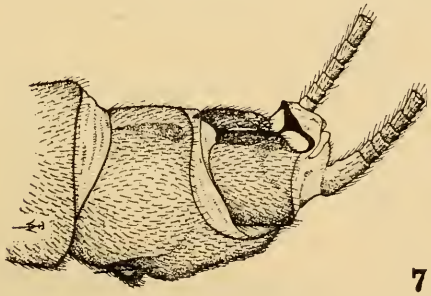

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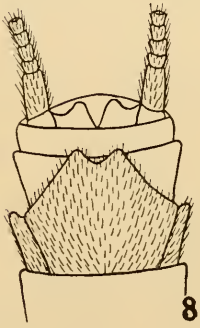


8

PLATE 24.

Genitalia of Neoperla, Perlinella, Atoperla, and Perlesta.

Fig. 1. *Neoperla clymene* Newm. ♂, dorsal view.
Fig. 2. *Neoperla clymene* Newm. ♂, side view.
Fig. 3. *Neoperla clymene* Newm. ♀, ventral view.
Fig. 4. *Neoperla clymene* Newm. egg.
Fig. 5. *Neoperla clymene* Newm. egg.
Fig. 6. *Perlinella drymo* Newm. ♂, dorsal view.
Fig. 7. *Perlinella drymo* Newm. ♂, lateral serrated chitinized plates of the penis.
Fig. 8. *Perlinella drymo* Newm. ♀, ventral view.
Fig. 9. *Perlinella drymo* Newm. ♂, ventral view.
Fig. 10. *Atoperla ephyre* Newm. ♀, ventral view.
Fig. 11. *Atoperla ephyre* Newm. egg.
Fig. 12. *Atoperla ephyre* Newm. egg.
Fig. 13. *Atoperla ephyre* Newm. ♂, dorsal view.
Fig. 14. *Atoperla ephyre* Newm. ♂, ventral view.
Fig. 15. *Perlesta placida* Hag. ♀, ventral view.
Fig. 16. *Perlesta placida* Hag. ♂, side view.
Fig. 17. *Perlesta placida* Hag. eggs.

PLATE 24.

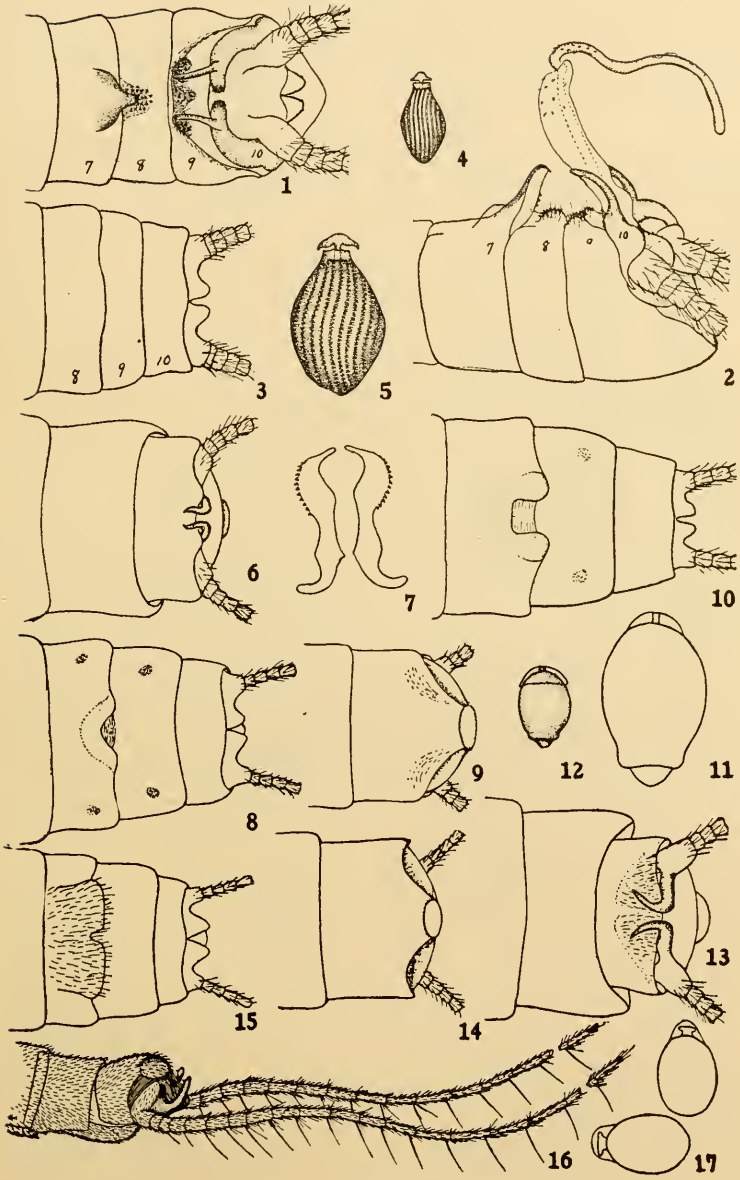


PLATE 25.

Genitalia of Clioperla, Perla and Isoperla.

Fig. 1. *Clioperla ebria* Hag. ♀, ventral view.
Fig. 2. *Clioperla ebria* Hag. ♂, dorsal view.
Fig. 3. *Clioperla ebria* Hag. ♂, ventral view.
Fig. 4. *Clioperla clio* Newm. ♂, ventral view.
Fig. 5. *Clioperla clio* Newm. ♀, ventral view.
Fig. 6. *Clioperla clio* Newm. ♂, dorsal view.
Fig. 7. *Clioperla gravitans* sp. nov. ♂, dorsal view.
Fig. 8. *Clioperla gravitans* sp. nov. ♂, ventral view.
Fig. 9. *Clioperla sobria* Hag. ♀, ventral view.
Fig. 10. *Perla sorpta* sp. nov. ♀, ventral view.
Fig. 11. *Clioperla marmorata* sp. nov. ♀, ventral view.
Fig. 12. *Isoperla marlynia* sp. nov. ♂, ventral view.
Fig. 13. *Isoperla marlynia* sp. nov. ♂, dorsal view.
Fig. 14. *Isoperla marlynia* sp. nov. ♀, ventral view.
Fig. 15. *Perla obscura* sp. nov. ♀, ventral view.

PLATE 25.

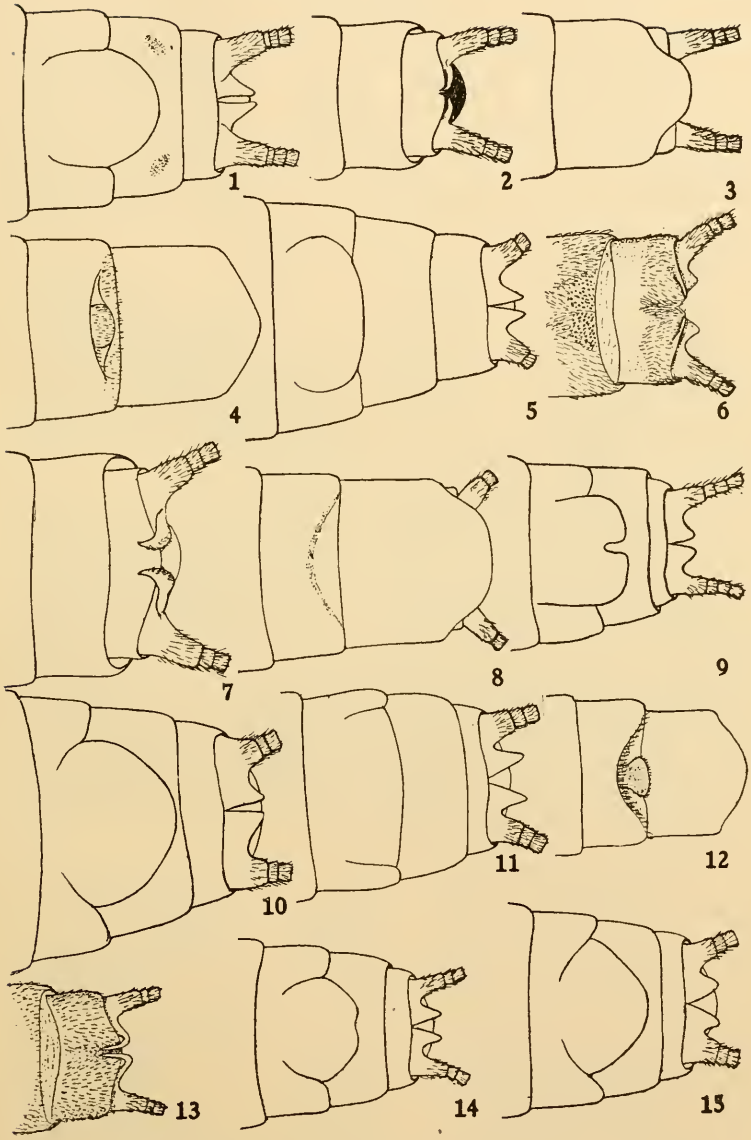


PLATE 26.

Genitalia of Isoperla.

Fig. 1. *Isoperla bellona* Bks. ♂, dorsal view.
Fig. 2. *Isoperla bellona* Bks. ♂, 8th sternite.
Fig. 3. *Isoperla bellona* Bks. ♀, ventral view.
Fig. 4. *Isoperla fusca* sp. nov. ♂, penis extruded.
Fig. 5. *Isoperla fusca* sp. nov. ♂, 8th sternite.
Fig. 6. *Isoperla fusca* sp. nov. ♀, ventral view.
Fig. 7. *Isoperla 5-punctata* Bks. ♂.
Fig. 8. *Isoperla 5-punctata* Bks. ♀, ventral view.
Fig. 9. *Isoperla bilineata* Say ♀, ventral view.
Fig. 10. *Isoperla bilineata* Say ♂, 8th sternite.
Fig. 11. *Isoperla 5-punctata* Bks. ♂, ventral view.
Fig. 12. *Isoperla bilineata* Say ♂.
Fig. 13. *Isoperla ventralis* Bks. ♂, 8th sternite.
Fig. 14. *Isoperla ventralis* Bks. ♂, dorsal view.
Fig. 15. *Isoperla longiseta* Bks. ♂, dorsal view.
Fig. 16. *Isoperla longiseta* Bks. ♂, 8th sternite.
Fig. 17. *Isoperla longiseta* Bks. ♀, ventral view.

PLATE 26.

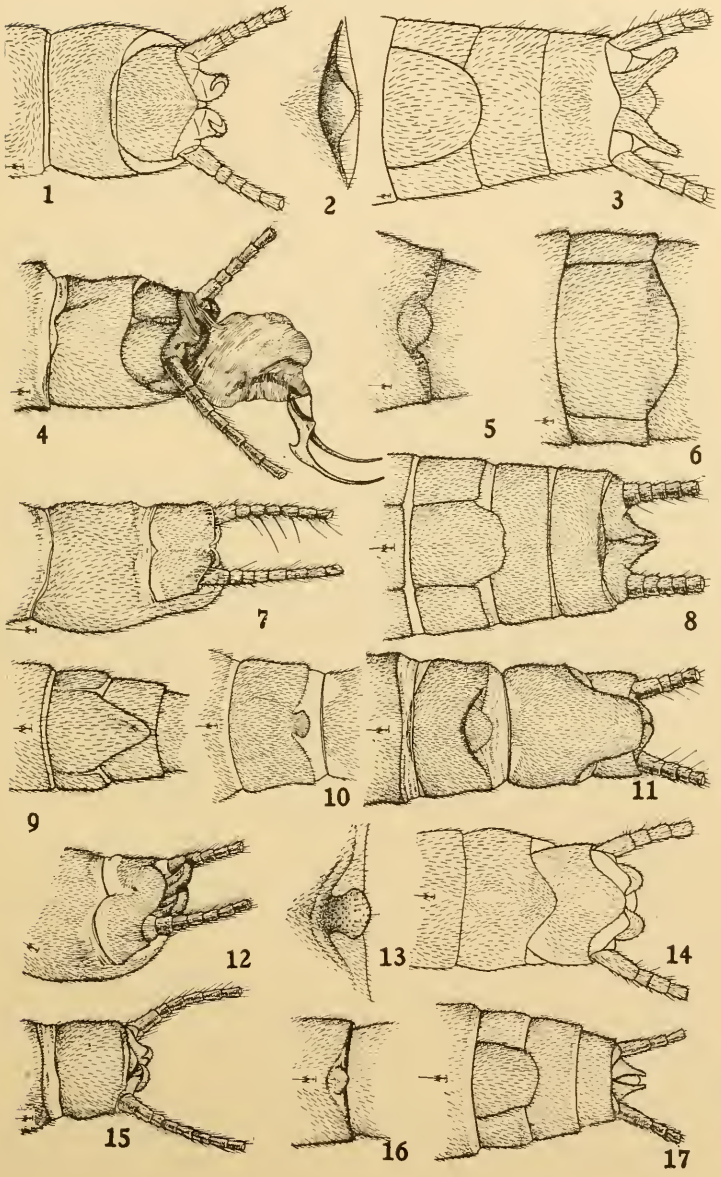


PLATE 27.

Genitalia of Isoperla.

Fig. 1. *Isoperla marmona* Bks. ♂, dorsal view.
Fig. 2. *Isoperla marmona* Bks. ♂, ventral view.
Fig. 3. *Isoperla marmona* Bks. ♀, ventral view.
Fig. 4. *Isoperla signata* Bks. ♂, dorsal view.
Fig. 5. *Isoperla signata* Bks. ♂, ventral view.
Fig. 6. *Isoperla signata* Bks. ♀, ventral view.
Fig. 7. *Isoperla minuta* Bks. ♂, dorsal view.
Fig. 8. *Isoperla minuta* Bks. ♂, ventral view.
Fig. 9. *Isoperla minuta* Bks. ♀, ventral view.
Fig. 10. *Isoperla montana* ♂, dorsal view.
Fig. 11. *Isoperla montana* ♂, ventral view.
Fig. 12. *Isoperla montana* ♀, ventral view.
Fig. 13. *Isoperla sordida* Bks. ♂, dorsal view.
Fig. 14. *Isoperla sordida* Bks. ♂, ventral view.
Fig. 15. *Isoperla sordida* Bks. ♀, ventral view.

PLATE 27.

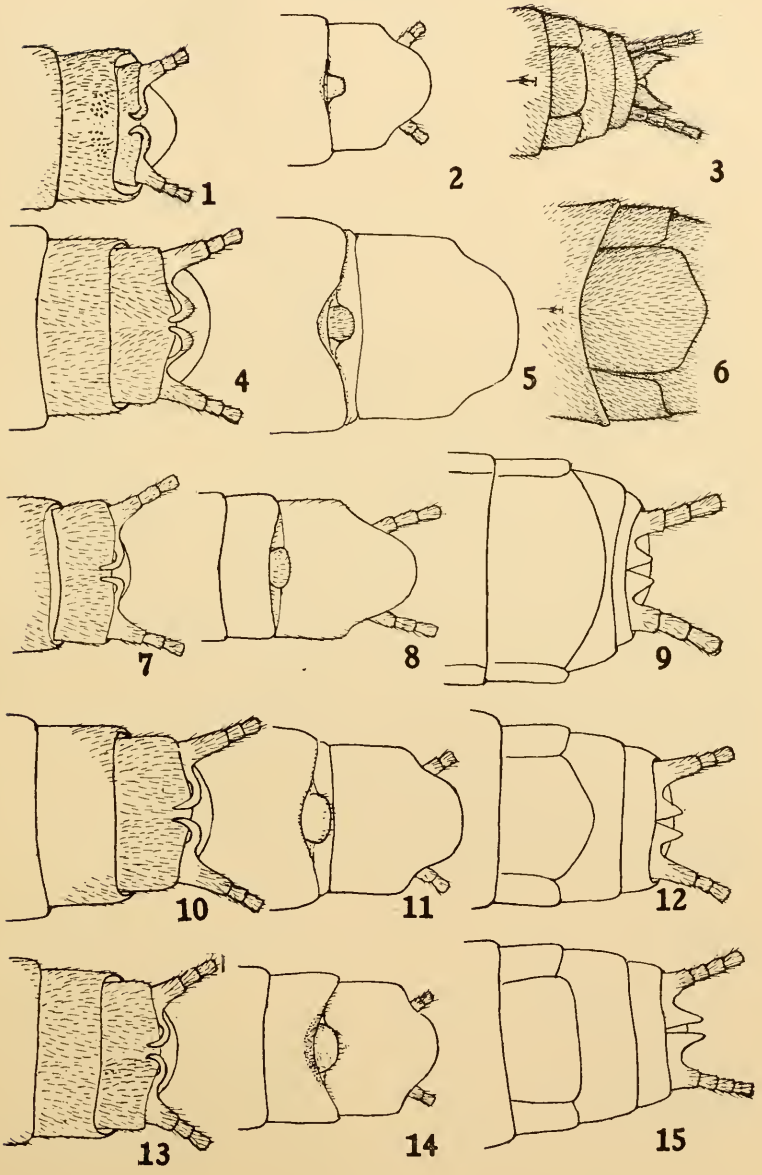


PLATE 28.

Genitalia of Acroneuria.

Fig. 1. *Acroneuria arenosa* Pict. ♂, dorsal view.
Fig. 2. *Acroneuria arenosa* Pict. ♀, ventral view.
Fig. 3. *Acroneuria abnormis* Newm. ♂, dorsal view.
Fig. 4. *Acroneuria abnormis* Newm. ♀, ventral view.
Fig. 5. *Acroneuria internata* Walk. ♀, ventral view.
Fig. 6. *Acroneuria internata* Walk. ♂, dorsal view.
Fig. 7. *Acroneuria arida* Hag. ♀, ventral view.
Fig. 8. *Acroneuria arida* Hag. ♂, dorsal view.
Fig. 9. *Acroneuria evoluta* Klap. ♂, dorsal view.
Fig. 10. *Acroneuria evoluta* Klap, ♀, ventral view.
Fig. 11. *Acroneuria lycorias* Newm. ♂, dorsal view.
Fig. 12. *Acroneuria lycorias* Newm. ♀, ventral view.
Fig. 13. *Acroneuria carolinensis* Bks. ♀, ventral view.
Fig. 14. *Acroneuria carolinensis* Bks. ♂, dorsal view.
Fig. 15. *Acroneuria depressa* Ndm. & Clsn. ♀, ventral view.
Fig. 16. *Acroneuria depressa* Ndm. & Clsn. ♂, dorsal view.
Fig. 17. *Acroneuria californica* Bks. ♂, dorsal view.
Fig. 18. *Acroneuria californica* Bks. ♂, ventral view.
Fig. 19. *Acroneuria californica* Bks. ♀, ventral view.
Fig. 20. *Acroneuria californica* Bks. ♀, ventral view.
Fig. 21. *Acroneuria theodora* Ndm. & Clsn. ♀, ventral view.
Fig. 22. *Acroneuria theodora* Ndm. & Clsn. ♂, ventral view.
Fig. 23. *Acroneuria theodora* Ndm. & Clsn. ♂, dorsal view.
Fig. 24. *Acroneuria trijuncta* Walk. ♀, ventral view.

PLATE 28.

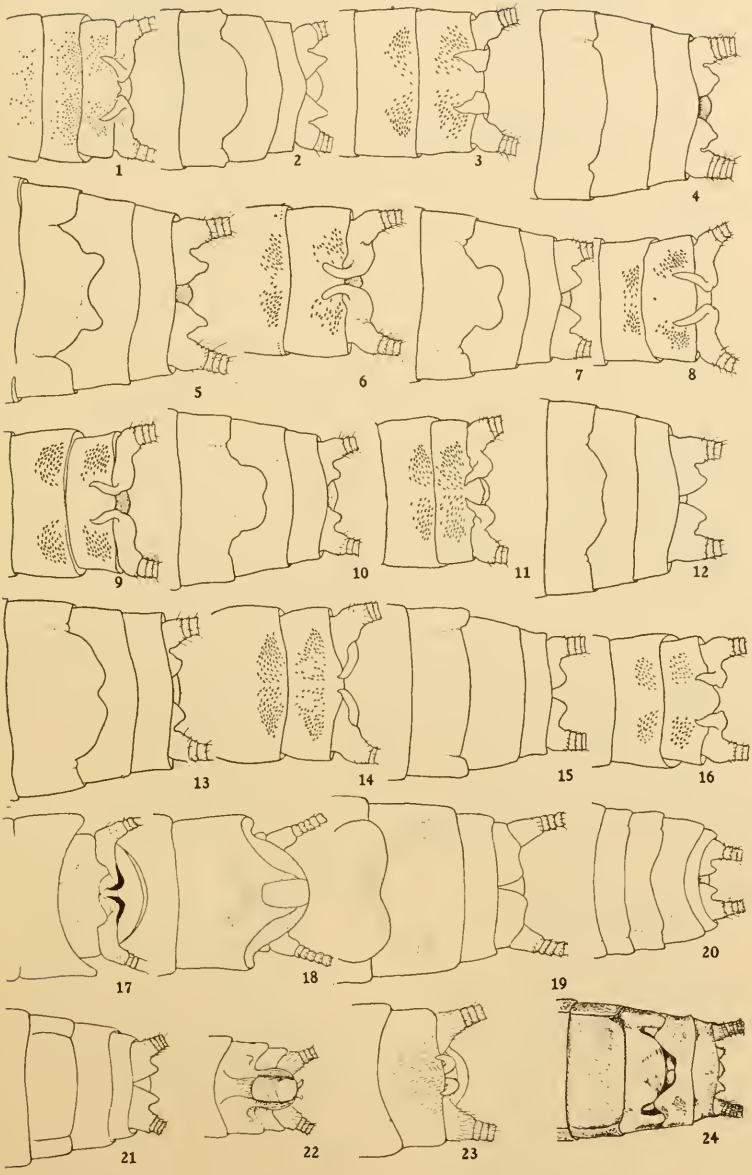


PLATE 29.

Genitalia of Acroneuria.

Fig. 1. *Acroneuria ruralis* Hag. ♂, dorsal view.
Fig. 2. *Acroneuria ruralis* Hag. ♀, ventral view.
Fig. 3. *Acroneuria pennsylvanica* Ramb. ♂, dorsal view.
Fig. 4. *Acroneuria pennsylvanica* Ramb. ♀, ventral view.
Fig. 5. *Acroneuria pumila* Bks. ♂, dorsal view.
Fig. 6. *Acroneuria pumila* Bks. ♀, ventral view.
Fig. 7. *Acroneuria pacifica* Bks. ♂, ventral view.
Fig. 8. *Acroneuria xanthenes* Newm. ♂, ventral view.
Fig. 9. *Acroneuria pacifica* Bks. ♀, ventral view.
Fig. 10. *Acroneuria pacifica* Bks. ♂, dorsal view.
Fig. 11. *Acroneuria xanthenes* Newm. ♂, dorsal view.
Fig. 12. *Acroneuria xanthenes* Newm. ♀, ventral view.

PLATE 29.

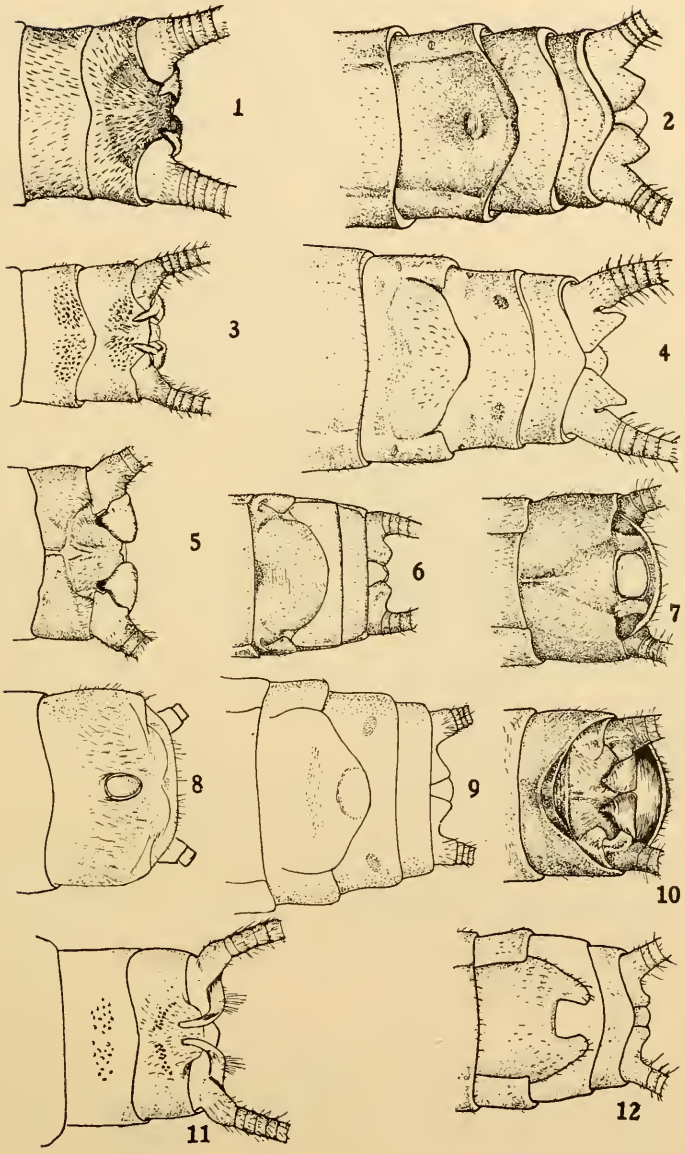


PLATE 30.

Eggs of Acroneuria.

Fig. 1. *Acroneuria californica* Bks.
Fig. 2. *Acroneuria xanthenes* Newm.
Fig. 3. *Acroneuria pacifica* Bks.
Fig. 4. *Acroneuria theodora* Ndm. & Clsn.
Fig. 5. *Acroneuria internata* Walk.
Fig. 6. *Acroneuria depressa* Ndm. & Clsn.
Fig. 7. *Acroneuria lycorias* Newm.
Fig. 8. *Acroneuria pennsylvanica* Ramb.
Fig. 9. *Acroneuria arida* Hag.
Fig. 10. *Acroneuria arenosa* Pict.
Fig. 11. *Acroneuria evoluta* Klap.
Fig. 12. *Acroneuria abnormis* Newm.
Fig. 13. *Acroneuria ruralis* Hag.
Fig. 14. *Acroneuria trijuncta* Walk.
Fig. 15. *Acroneuria pumila* Bks.

Drawings by Dr. Hazel E. Branch.

PLATE 30.

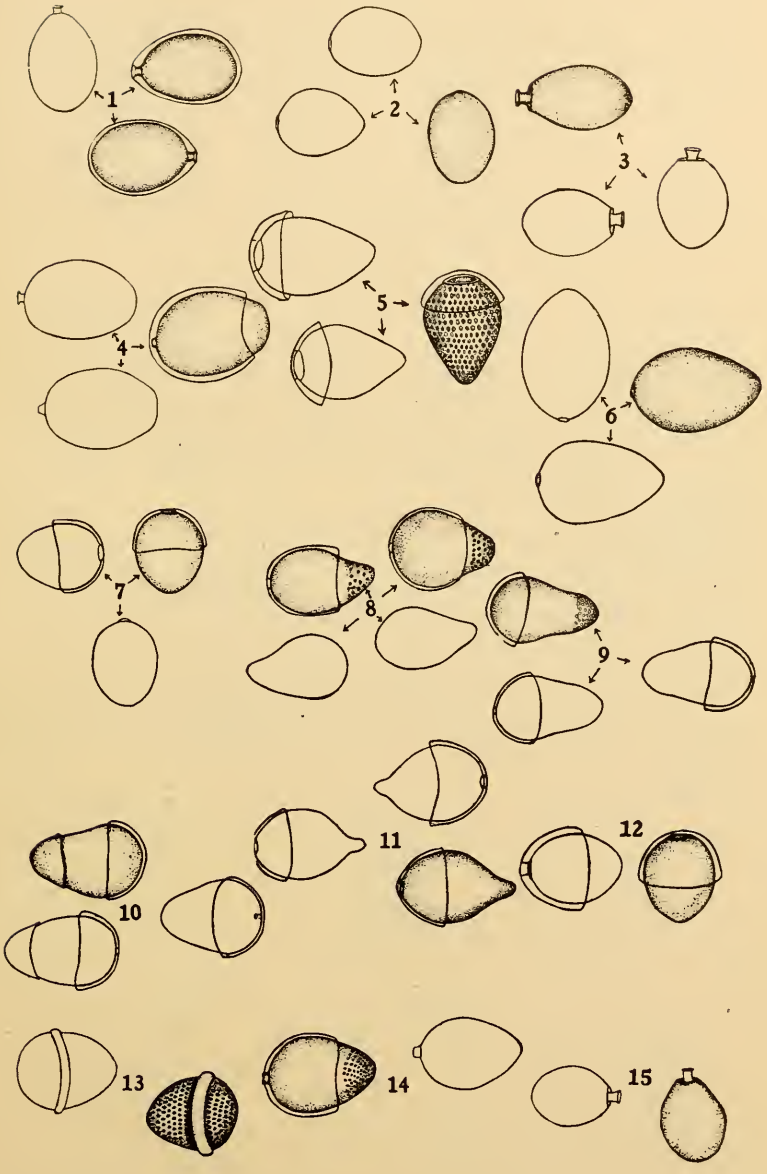


PLATE 31.

Genitalia of Peltoperla.

Fig. 1. *Peltoperla arcuata* Ndm. ♂, dorsal view.
Fig. 2. *Peltoperla arcuata* Ndm. ♂, ventral view.
Fig. 3. *Peltoperla arcuata* Ndm. ♀, ventral view.
Fig. 4. *Peltoperla cornelia* Ndm. & Sm. ♂, dorsal view.
Fig. 5. *Peltoperla cornelia* Ndm. & Sm. ♂, ventral view.
Fig. 6. *Peltoperla cornelia* Ndm. & Sm. ♀, ventral view.
Fig. 7. *Peltoperla maria* Ndm. & Sm. ♀, ventral view.
Fig. 8. *Peltoperla anna* Ndm. & Sm. ♀, ventral view.
Fig. 9. *Peltoperla thyra* Ndm. & Sm. ♂, side view.
Fig. 10. *Peltoperla thyra* Ndm. & Sm. ♂, supra-anal process.
Fig. 11. *Peltoperla brevis* Bks. ♂, ventral view.
Fig. 12. *Peltoperla brevis* Bks. ♂, dorsal view.
Fig. 13. *Peltoperla brevis* Bks. ♀, ventral view.
Fig. 14. *Peltoperla cora* Ndm. & Sm. ♂, dorsal view.
Fig. 15. *Peltoperla cora* Ndm. & Sm. ♂, ventral view.
Fig. 16. *Peltoperla cora* Ndm. & Sm. ♀, ventral view.

PLATE 31.

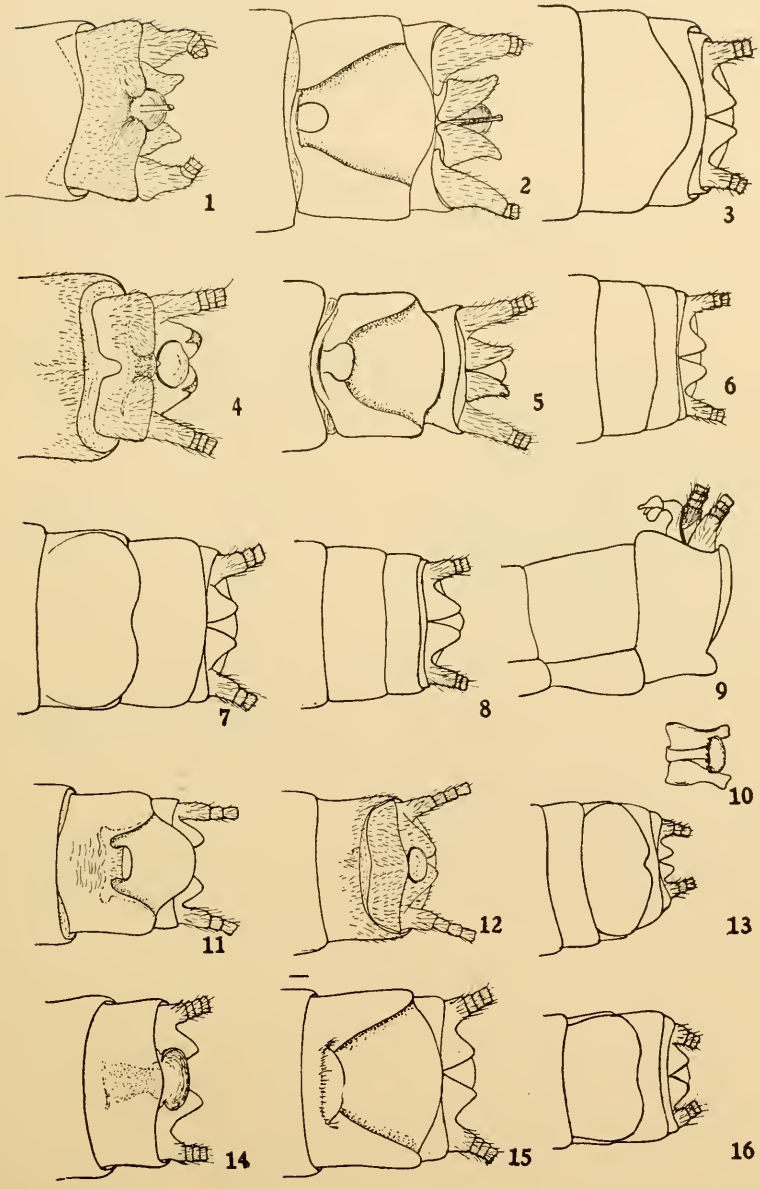


PLATE 32.

Wings of Nemoura, Perlomyia and Leuctra.

Fig. 1. *Leuctra bradleyi* Clsn.
Fig. 2. *Nemoura cinctipes* Bks.
Fig. 3. *Nemoura punctipennis* Clsn.
Fig. 4. *Leuctra carolinensis* Clsn.
Fig. 5. *Perlomyia utahensis* sp. nov.
Fig. 6. *Nemoura depressa* Bks.

PLATE 32.

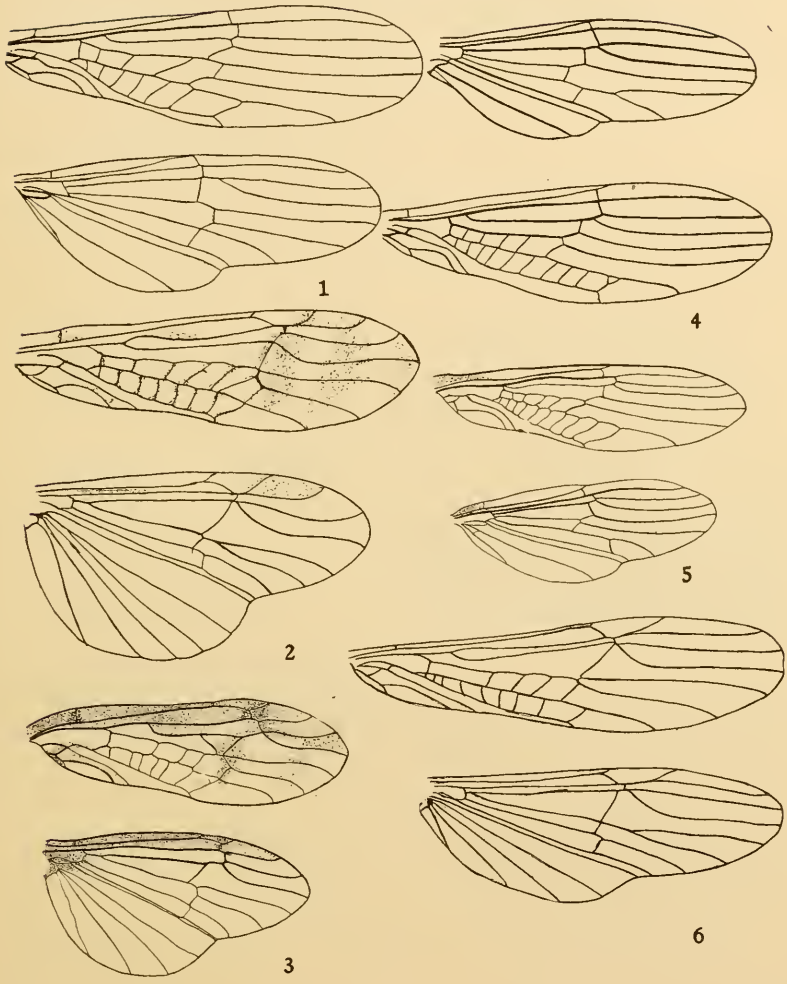


PLATE 33.

Wings of Taeniopteryx and Capnia.

Fig. 1. *Taeniopteryx nivalis* Fitch.
Fig. 2. *Taeniopteryx fasciata* Burm.
Fig. 3. *Taeniopteryx occidentalis* Bks.
Fig. 4. *Taeniopteryx maura* Pict.
Fig. 5. *Taeniopteryx pacifica* Bks.
Fig. 6. *Capnia crinita* sp. nov.

PLATE 33.

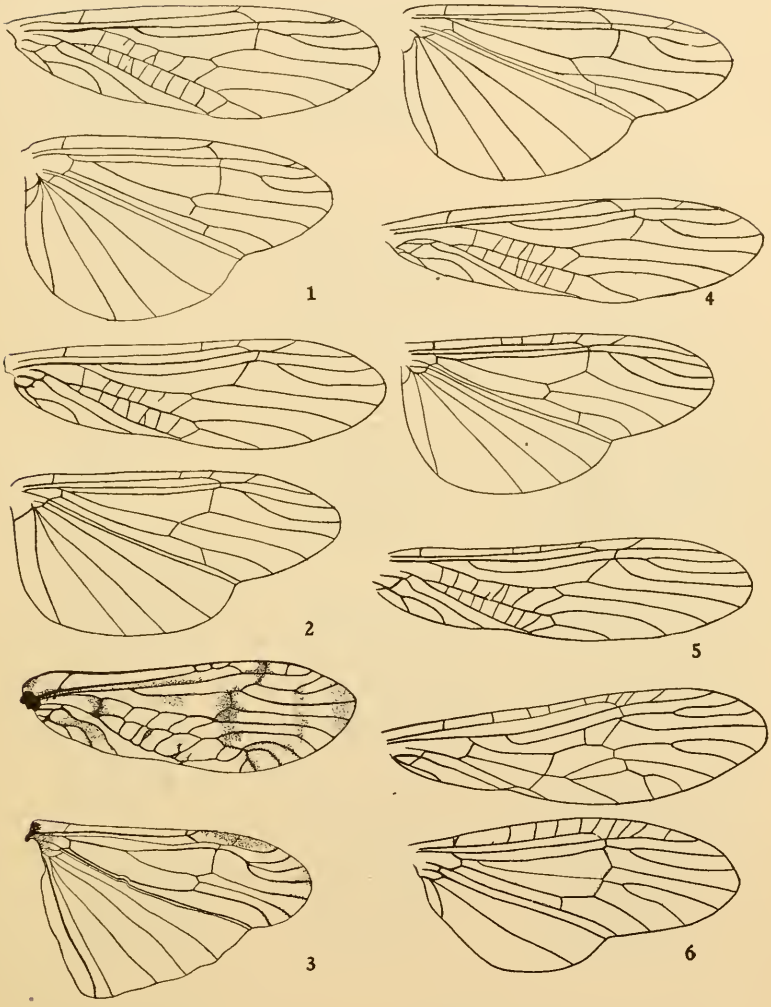
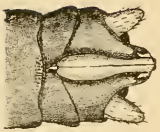


PLATE 34.

Genitalia of Nemoura.

Fig. 1. *Nemoura glabra* Clsn. ♂, dorsal view.
Fig. 2. *Nemoura glabra* Clsn. ♂, ventral view.
Fig. 3. *Nemoura glabra* Clsn. ♂, side view.
Fig. 4. *Nemoura glabra* Clsn. ♀, ventral view.
Fig. 5. *Nemoura frigida* Clsn. ♂, dorsal view.
Fig. 6. *Nemoura frigida* Clsn. ♂, ventral view.
Fig. 7. *Nemoura frigida* Clsn. ♂, side view.
Fig. 8. *Nemoura divergens* Clsn. ♂, dorsal view.
Fig. 9. *Nemoura divergens* Clsn. ♂, ventral view.
Fig. 10. *Nemoura divergens* Clsn. ♂, side view.
Fig. 11. *Nemoura columbiana* Clsn. ♂, dorsal view.
Fig. 12. *Nemoura columbiana* Clsn. ♂, ventral view.
Fig. 13. *Nemoura columbiana* Clsn. ♂, side view.
Fig. 14. *Nemoura delicatula* Clsn. ♂, dorsal view.
Fig. 15. *Nemoura delicatula* Clsn. ♂, ventral view.
Fig. 16. *Nemoura delicatula* Clsn. ♂, side view.
Fig. 17. *Nemoura delicatula* Clsn. ♀, ventral view.
Fig. 18. *Nemoura bifurcata* Clsn. ♂, dorsal view.
Fig. 19. *Nemoura bifurcata* Clsn. ♂, ventral view.
Fig. 20. *Nemoura bifurcata* Clsn. ♂, side view.

PLATE 34.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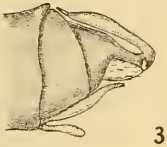
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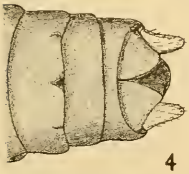
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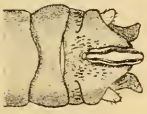
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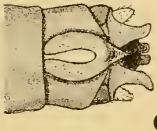
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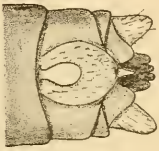
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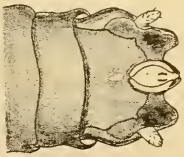
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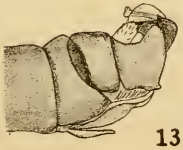
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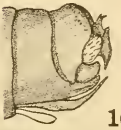
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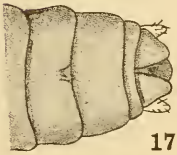
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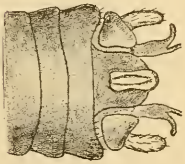
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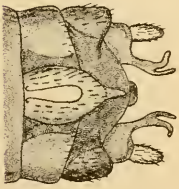
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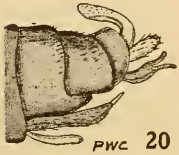

PWC 20

PLATE 35.

Genitalia of Nemoura.

Fig. 1. *Nemoura biloba* Clsn. ♂, dorsal view.
Fig. 2. *Nemoura biloba* Clsn. ♂, ventral view.
Fig. 3. *Nemoura biloba* Clsn. ♂, side view.
Fig. 4. *Nemoura biloba* Clsn. ♀, ventral view.
Fig. 5. *Nemoura flexura* Clsn. ♂, dorsal view.
Fig. 6. *Nemoura flexura* Clsn. ♂, ventral view.
Fig. 7. *Nemoura flexura* Clsn. ♂, side view.
Fig. 8. *Nemoura flexura* Clsn. ♀, ventral view.
Fig. 9. *Nemoura depressa* Bks. ♂, dorsal view.
Fig. 10. *Nemoura depressa* Bks. ♂, ventral view.
Fig. 11. *Nemoura depressa* Bks. ♂, side view.
Fig. 12. *Nemoura depressa* Bks. ♀, ventral view.
Fig. 13. *Nemoura cornuta* Clsn. ♂, dorsal view.
Fig. 14. *Nemoura cornuta* Clsn. ♂, ventral view.
Fig. 15. *Nemoura cornuta* Clsn. ♂, side view.
Fig. 16. *Nemoura californica* Clsn. ♂, dorsal view.
Fig. 17. *Nemoura californica* Clsn. ♂, ventral view.
Fig. 18. *Nemoura californica* Clsn. ♂, side view.
Fig. 19. *Nemoura californica* Clsn. ♀, ventral view.

PLATE 35.

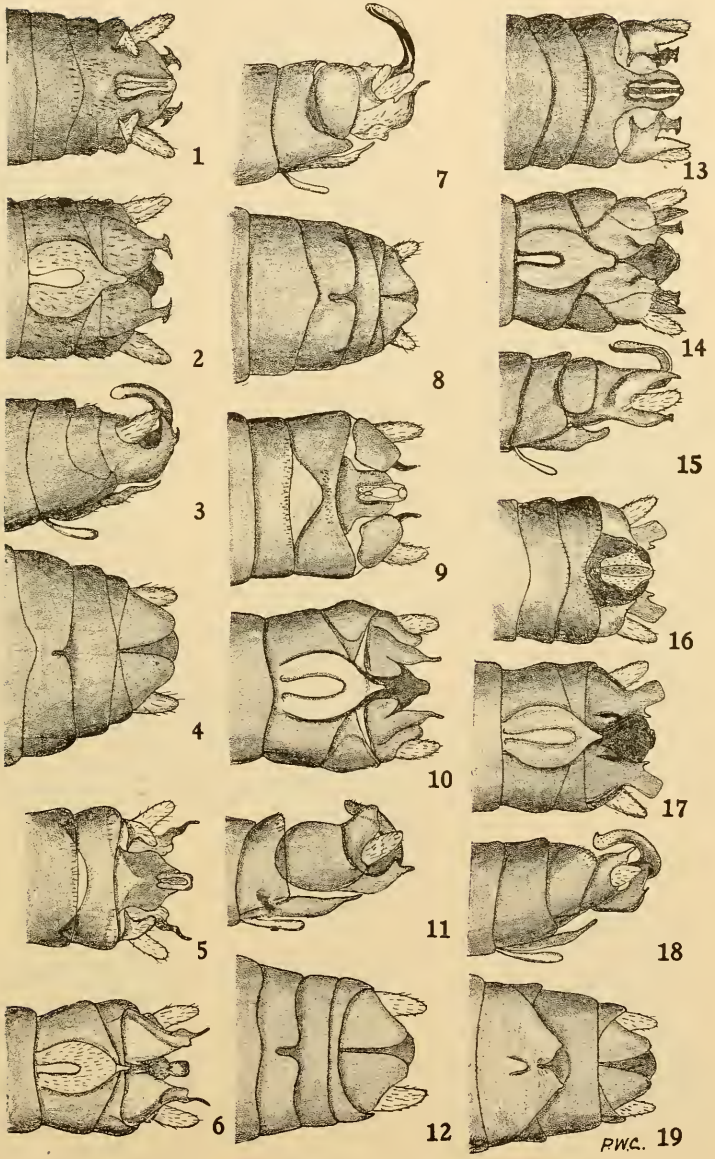


PLATE 36.

Genitalia of Nemoura.

Fig. 1. *Nemoura sinuata* Wu ♂, dorsal view.
Fig. 2. *Nemoura sinuata* Wu ♂, ventral view.
Fig. 3. *Nemoura sinuata* Wu ♂, side view.
Fig 4. *Nemoura sinuata* Wu ♀, ventral view.
Fig. 5. *Nemoura venusta* Bks. ♀, ventral view.
Fig. 6. *Nemoura venusta* Bks. ♂, dorsal view.
Fig. 7. *Nemoura venusta* Bks. ♂, ventral view.
Fig. 8. *Nemoura venusta* Bks. ♂, side view.
Fig. 9. *Nemoura venosa* Bks. ♂, dorsal view.
Fig. 10. *Nemoura venosa* Bks. ♂, ventral view.
Fig. 11. *Nemoura venosa* Bks. ♂, side view.
Fig. 12. *Nemoura venosa* Bks. ♀, ventral view.
Fig. 13. *Nemoura coloradensis* Bks. ♂, dorsal view.
Fig. 14. *Nemoura coloradensis* Bks. ♂, ventral view.
Fig. 15. *Nemoura coloradensis* Bks. ♂, side view.
Fig. 16. *Nemoura coloradensis* Bks. ♀, ventral view.

PLATE 36.

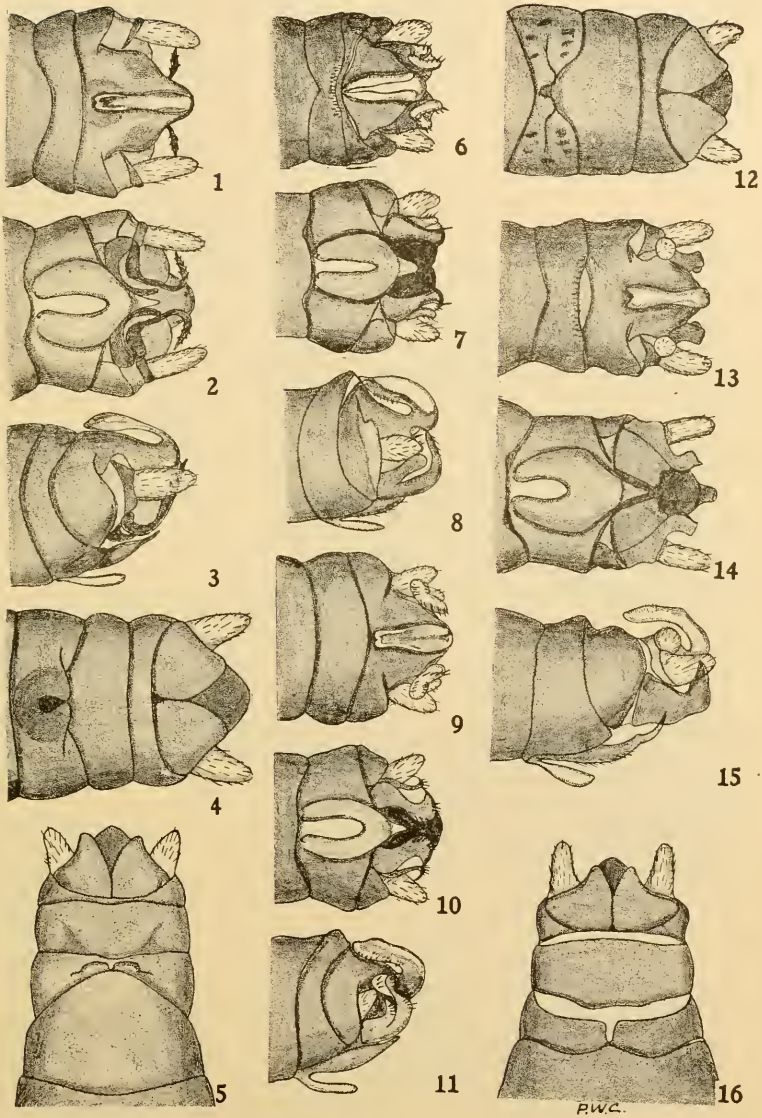


PLATE 37.

Genitalia of Nemoura.

Fig. 1. *Nemoura producta* Clsn. ♂, dorsal view.
Fig. 2. *Nemoura producta* Clsn. ♂, ventral view.
Fig. 3. *Nemoura producta* Clsn. ♂, side view.
Fig. 4. *Nemoura producta* Clsn. ♀, ventral view.
Fig. 5. *Nemoura cinctipes* Bks. ♂, dorsal view.
Fig. 6. *Nemoura cinctipes* Bks. ♂, ventral view.
Fig. 7. *Nemoura cinctipes* Bks. ♂, side view.
Fig. 8. *Nemoura cinctipes* Bks. ♀, ventral view.
Fig. 9. *Nemoura oregonensis* Clsn. ♂, dorsal view.
Fig. 10. *Nemoura oregonensis* Clsn. ♂, ventral view.
Fig. 11. *Nemoura oregonensis* Clsn. ♂, side view.
Fig. 12. *Nemoura trispinosa* Clsn. ♂, dorsal view.
Fig. 13. *Nemoura trispinosa* Clsn. ♂, ventral view.
Fig. 14. *Nemoura trispinosa* Clsn. ♂, side view.
Fig. 15. *Nemoura trispinosa* Clsn. ♀, ventral view.
Fig. 16. *Nemoura similis* Hag. ♀, ventral view.

PLATE 37.

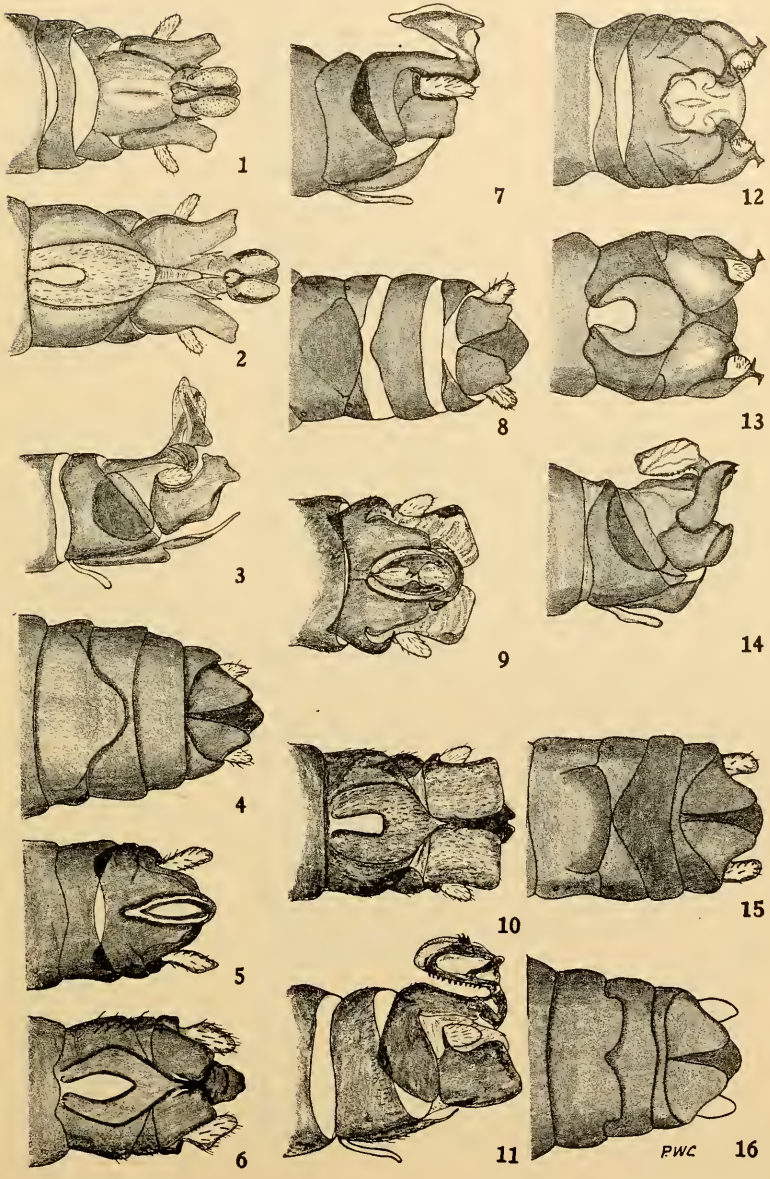


PLATE 38.

Genitalia of Nemoura.

Fig. 1. *Nemoura vallicularia* Wu ♂, dorsal view.
Fig. 2. *Nemoura vallicularia* Wu ♂, ventral view.
Fig. 3. *Nemoura vallicularia* Wu ♂, side view.
Fig. 4. *Nemoura vallicularia* Wu ♀, ventral view.
Fig. 5. *Nemoura carolinensis* Clsn. ♂, dorsal view.
Fig. 6. *Nemoura carolinensis* Clsn. ♂, ventral view.
Fig. 7. *Nemoura carolinensis* Clsn. ♂, side view.
Fig. 8. *Nemoura nevadensis* Clsn. ♂, dorsal view.
Fig. 9. *Nemoura nevadensis* Clsn. ♂, ventral view.
Fig. 10. *Nemoura nevadensis* Clsn. ♂, side view.
Fig. 11. *Nemoura nevadensis* Clsn. ♀, ventral view.
Fig. 12. *Nemoura washingtoniana* Clsn. ♂, dorsal view.
Fig. 13. *Nemoura washingtoniana* Clsn. ♂, ventral view.
Fig. 14. *Nemoura washingtoniana* Clsn. ♂, side view.
Fig. 15. *Namoura washingtoniana* Clsn. ♀, ventral view.
Fig. 16. *Nemoura interrupta* Clsn. ♂, dorsal view.
Fig. 17. *Nemoura interrupta* Clsn. ♂, ventral view.
Fig. 18. *Nemoura interrupta* Clsn. ♂, side view.

PLATE 38.

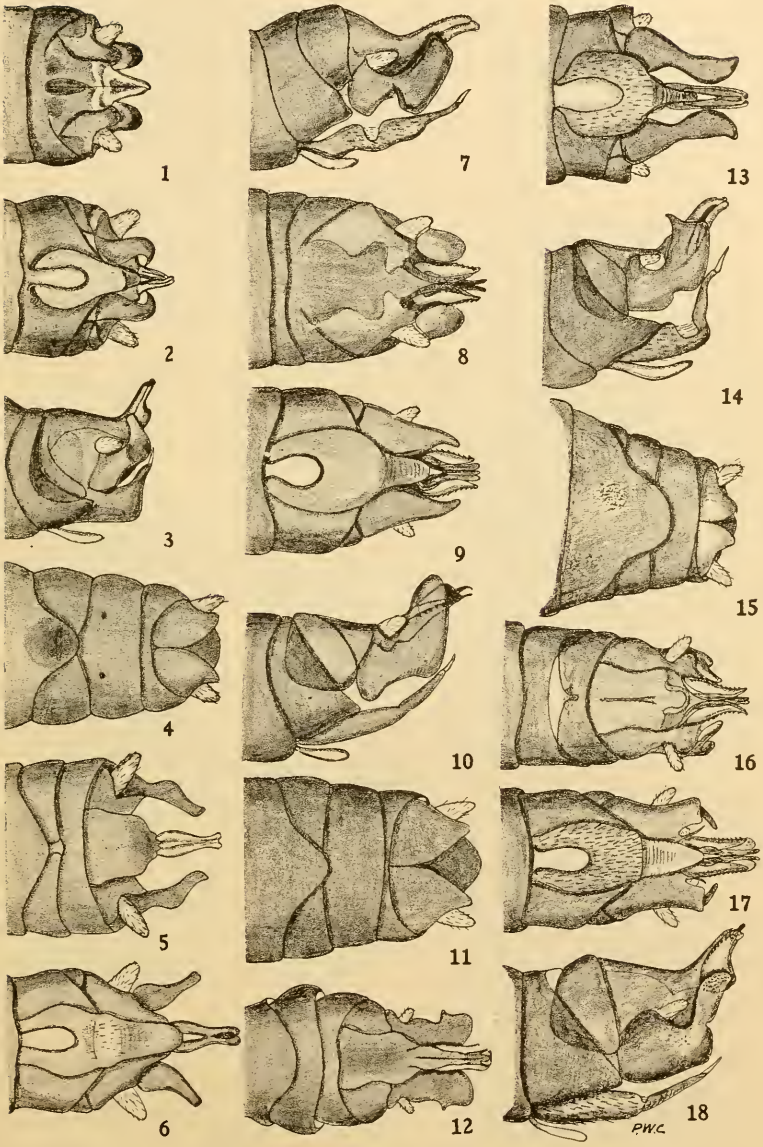


PLATE 39.

Genitalia of Nemoura.

Fig. 1. *Nemoura truncata* Clsn. ♂, dorsal view.
Fig. 2. *Nemoura truncata* Clsn. ♂, ventral view.
Fig. 3. *Nemoura truncata* Clsn. ♂, side view.
Fig. 4. *Nemoura serrata* Clsn, ♂, dorsal view.
Fig. 5. *Nemoura serrata* Clsn. ♂, ventral view.
Fig. 6. *Nemoura serrata* Clsn. ♂, side view.
Fig. 7. *Nemoura prolongata* Clsn. ♂, dorsal view.
Fig. 8. *Nemoura prolongata* Clsn. ♂, ventral view.
Fig. 9. *Nemoura prolongata* Clsn. ♂, side view.
Fig. 10. *Nemoura prolongata* Clsn. ♀, ventral view.
Fig. 11. *Nemoura rotunda* Clsn. ♂, ventral view.
Fig. 12. *Nemoura rotunda* Clsn. ♂, side view.
Fig. 13. *Nemoura rotunda* Clsn. ♂, dorsal view.
Fig. 14. *Nemoura rotunda* Clsn. ♀, ventral view.
Fig. 15. *Nemoura stigmata* Bks. ♂, dorsal view.
Fig. 16. *Nemoura stigmata* Bks. ♂, ventral view.
Fig. 17. *Nemoura stigmata* Bks. ♂, side view.
Fig. 18. *Nemoura punctipennis* Clsn. ♀, ventral view.
Fig. 19. *Nemoura punctipennis* Clsn. ♂, dorsal view.
Fig. 20. *Nemoura punctipennis* Clsn. ♂, side view.

PLATE 39.

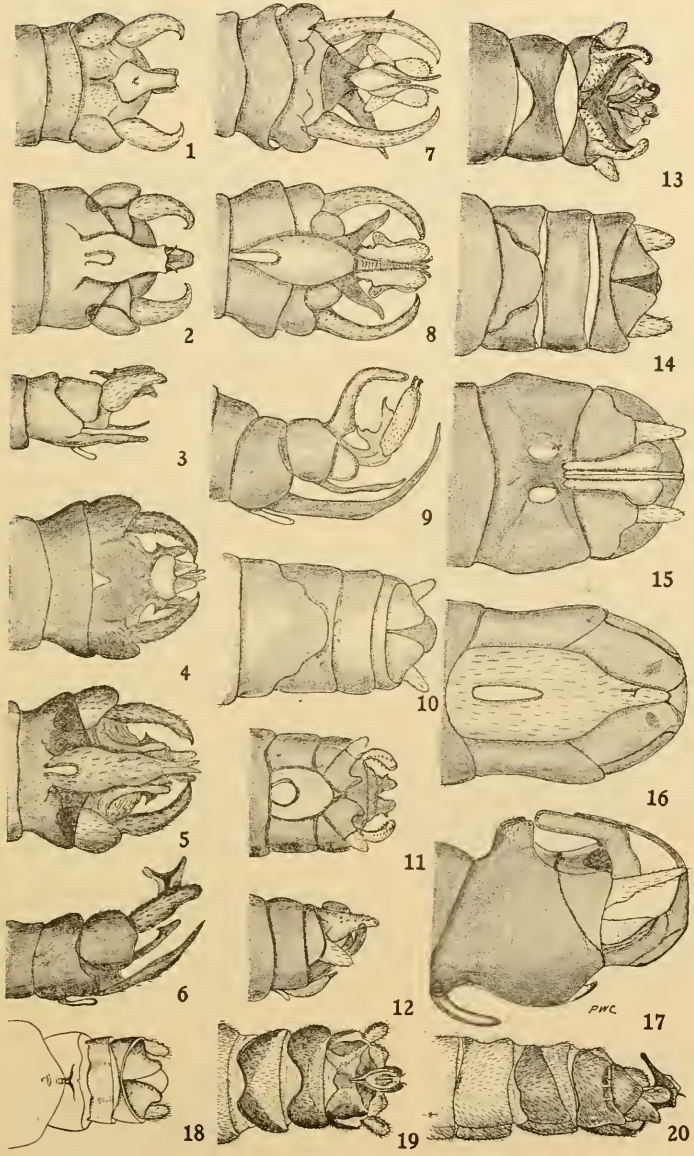


PLATE 40.

Male Genitalia of Leuctra.

Fig. 1. *Leuctra hamula* Clsn. ♂, dorsal view.
Fig. 2. *Leuctra hamula* Clsn. ♂, side view.
Fig. 3. *Leuctra truncata* Clsn. ♂, dorsal view.
Fig. 4. *Leuctra truncata* Clsn. ♂, side view.
Fig. 5. *Leuctra decepta* Clsn. ♂, dorsal view.
Fig. 6. *Leuctra decepta* Clsn. ♂, side view.
Fig. 7. *Leuctra tenuis* Piet. ♂, dorsal view.
Fig. 8. *Leuctra tenuis* Piet. ♂, side view.
Fig. 9. *Leuctra biloba* Clsn. ♂, dorsal view.
Fig. 10. *Leuctra biloba* Clsn. ♂, side view.
Fig. 11. *Leuctra grandis* Bks. ♂, dorsal view.
Fig. 12. *Leuctra grandis* Bks. ♂, side view.
Fig. 13. *Leuctra triloba* Clsn. ♂, dorsal view.
Fig. 14. *Leuctra triloba* Clsn. ♂, side view.
Fig. 15. *Leuctra sibleyi* Clsn. ♂, dorsal view.
Fig. 16. *Leuctra sibleyi* Clsn. ♂, side view.

PLATE 40.

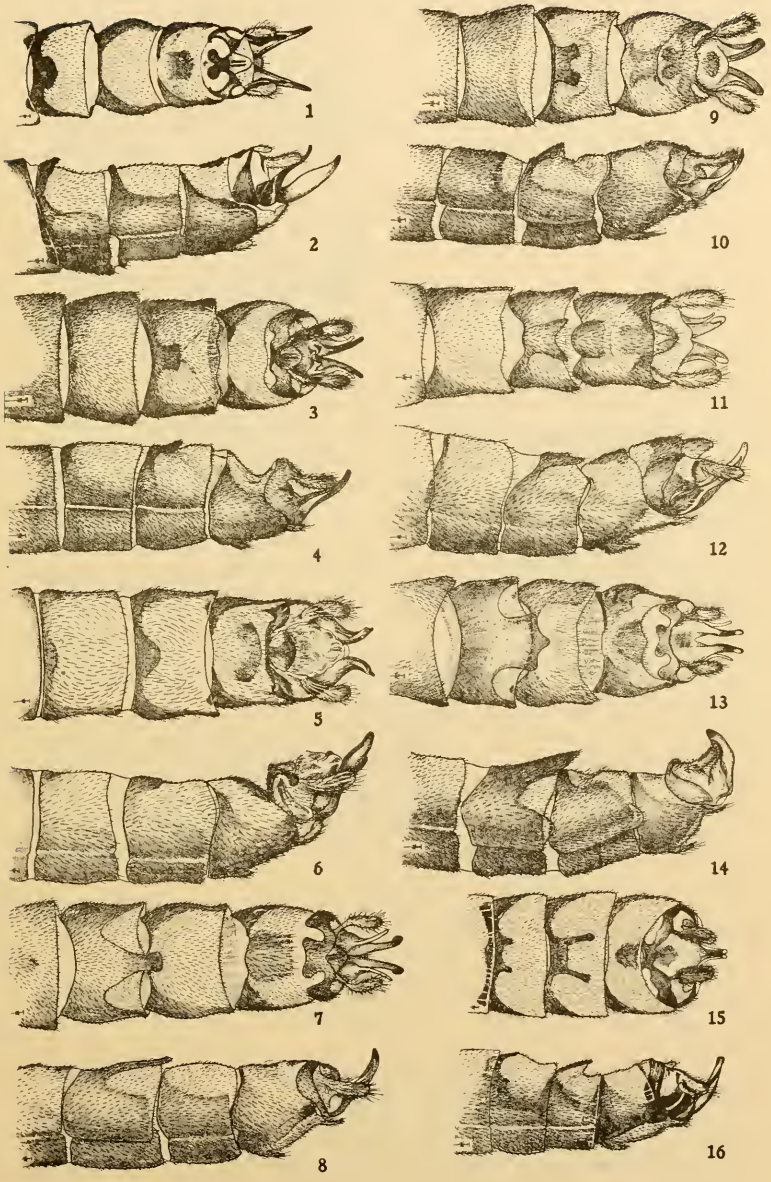


PLATE 41.

Male Genitalia of Leuctra.

Fig. 1. *Leuctra carolinensis* Clsn. ♂, dorsal view.
Fig. 2. *Leuctra carolinensis* Clsn. ♂, side view.
Fig. 3. *Leuctra carolinensis* Clsn. ♂, ventral view.
Fig. 4. *Leuctra duplicata* Clsn. ♂, dorsal view.
Fig. 5. *Leuctra duplicata* Clsn. ♂, side view.
Fig. 6. *Leuctra occidentalis* Bks. ♂, dorsal view.
Fig. 7. *Leuctra occidentalis* Bks. ♂, side view.
Fig. 8. *Leuctra occidentalis* Bks. ♂, ventral view.
Fig. 9. *Leuctra glabra* Clsn. ♂, dorsal view.
Fig. 10. *Leuctra glabra* Clsn. ♂, side view.
Fig. 11. *Leuctra glabra* Clsn. ♂, ventral view.
Fig. 12. *Leuctra bradleyi* Clsn. ♂, side view.
Fig. 13. *Leuctra bradleyi* Clsn. ♂, dorsal view.
Fig. 14. *Leuctra bradleyi* Clsn. ♂, side view showing supra-anal process drawn out.
Fig. 15. *Leuctra bradleyi* Clsn. ♂, ventral view.

PLATE 41.

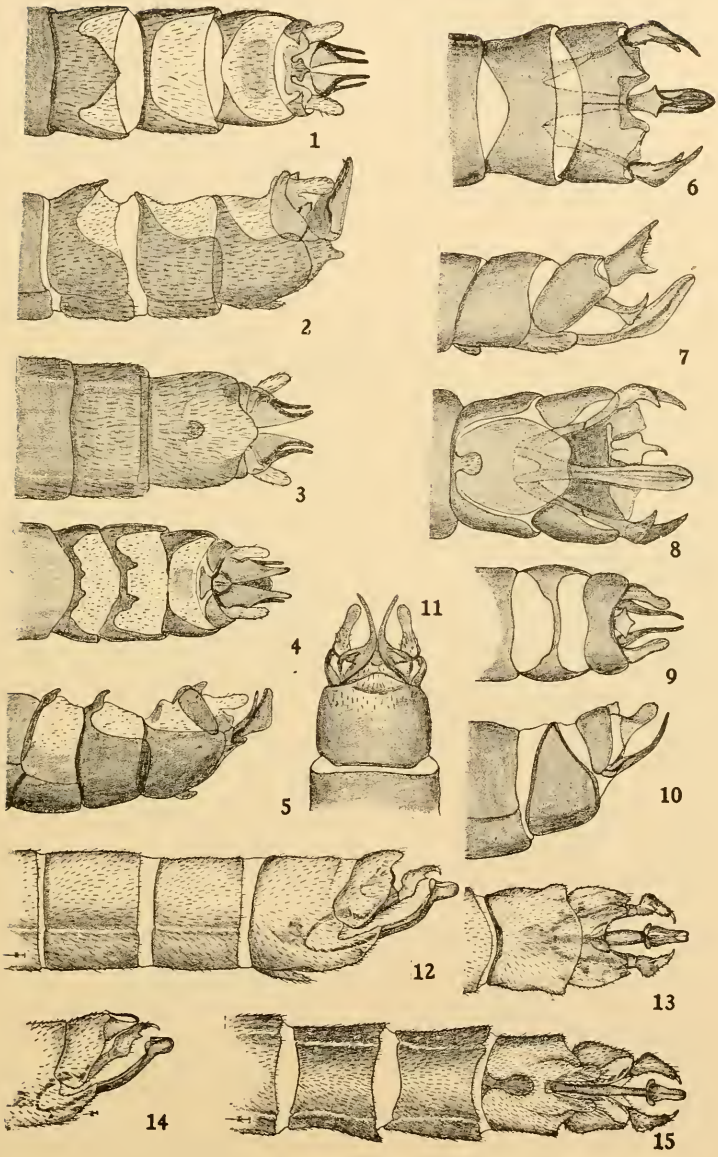


PLATE 42.

Female Genitalia of Leuctra.

Fig. 1. *Leuctra augusta* Bks.
Fig. 2. *Leuctra hamula* Clsn.
Fig. 3. *Leuctra truncata* Clsn.
Fig. 4. *Leuctra decepta* Clsn.
Fig. 5. *Leuctra tenuis* Pict.
Fig. 6. *Leuctra biloba* Clsn.
Fig. 7. *Leuctra grandis* Bks.
Fig. 8. *Leuctra triloba* Clsn.
Fig. 9. *Leuctra duplicata* Clsn.
Fig. 10. *Leuctra carolinensis* Clsn.
Fig. 11. *Leuctra sibleyi* Clsn.
Fig. 12. *Leuctra occidentalis* Bks.

PLATE 42.

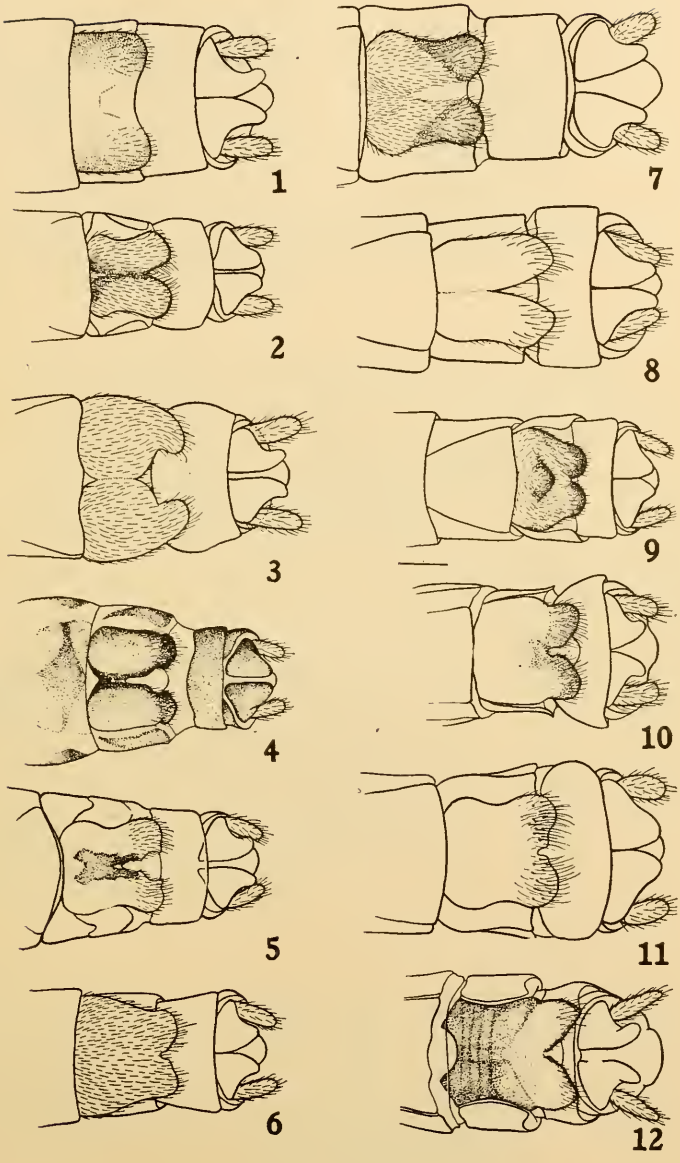
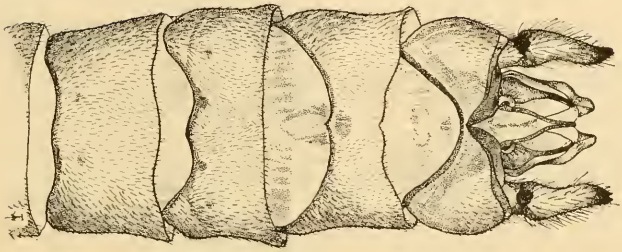


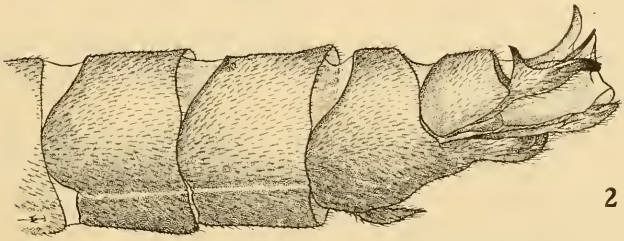
PLATE 43.

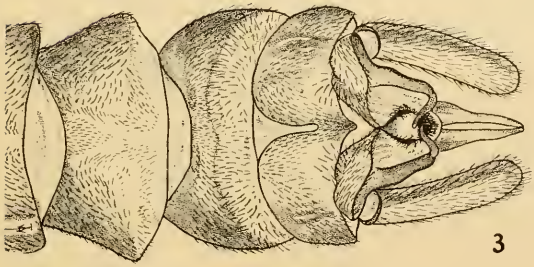
Genitalia of Perlomyia and Leuctra.

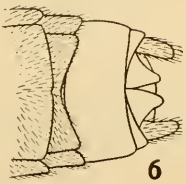
Fig. 1. *Perlomyia utahensis* sp. nov. ♂, dorsal view.
Fig. 2. *Perlomyia utahensis* sp nov. ♂, side view.
Fig. 3. *Leuctra infuscata* Clsn. ♂, dorsal view.
Fig. 4. *Leuctra infuscata* Clsn. ♀, ventral view.
Fig. 5. *Leuctra infuscata* Clsn. ♂, side view.
Fig. 6. *Perlomyia collaris* Bks. ♀, ventral view.

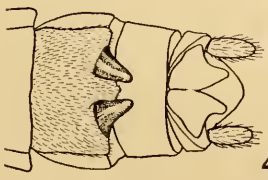
PLATE 43.











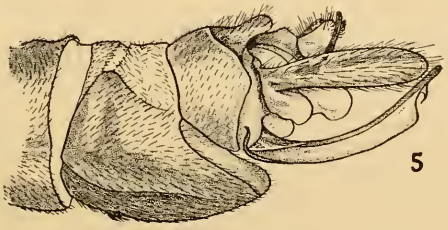
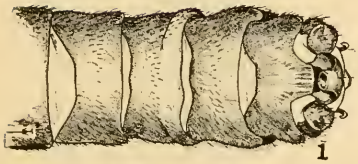


PLATE 44.

Male Genitalia of Taeniopteryx.

Fig. 1. *Taeniopteryx parvula* Bks. ♂, dorsal view.
Fig. 2. *Taeniopteryx parvula* Bks. ♂, side view.
Fig. 3. *Taeniopteryx nivalis* Fitch ♂, dorsal view.
Fig. 4. *Taeniopteryx nivalis* Fitch ♂, side view.
Fig. 5. *Taeniopteryx maura* Pict. ♂, dorsal view.
Fig. 6. *Taeniopteryx maura* Pict. ♂, side view.
Fig. 7. *Taeniopteryx oregonensis* sp. nov. ♂, dorsal view.
Fig. 8. *Taeniopteryx oregonensis* sp. nov. ♂, side view.

PLATE 44.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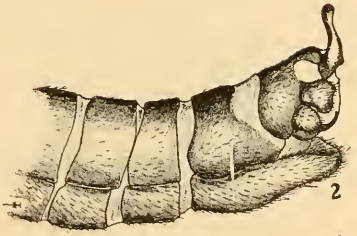
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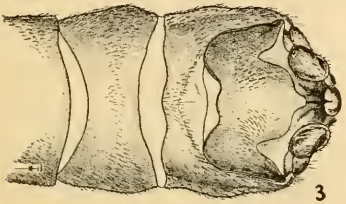
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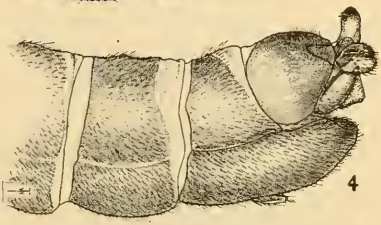
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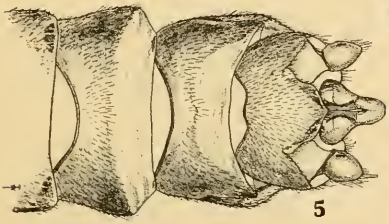
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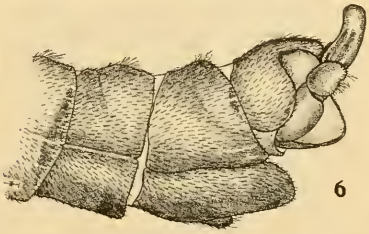
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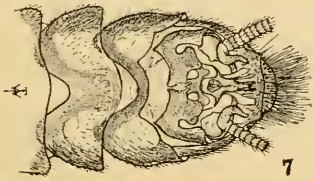
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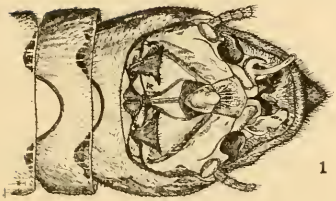
PLATE 45.

Male Genitalia of Taeniopteryx.

Fig. 1. *Taeniopteryx occidentalis* Bks. ♂, dorsal view.
Fig. 2. *Taeniopteryx occidentalis* Bks. ♂, side view.
Fig. 3. *Taeniopteryx fasciata* Burm. ♂, dorsal view.
Fig. 3a. *Taeniopteryx fasciata* Burm. ♂, subanal lobes.
Fig. 4. *Taeniopteryx fasciata* Burm. ♂, side view.
Fig. 5. *Taeniopteryx contorta* sp. nov. ♂, dorsal view.
Fig. 6. *Taeniopteryx contorta* sp. nov. ♂, side view.
Fig. 7. *Taeniopteryx nigripennis* Bks. ♂, dorsal view.
Fig. 8. *Taeniopteryx nigripennis* Bks. ♂, side view.
Fig. 9. *Taeniopteryx californica* sp. nov. ♂, dorsal view.
Fig. 10. *Taeniopteryx californica* sp. nov. ♂, side view.
Fig. 11. *Taeniopteryx pacifica* Bks. ♂, dorsal view.
Fig. 12. *Taeniopteryx pacifica* Bks. ♂, side view.

PLATE 45.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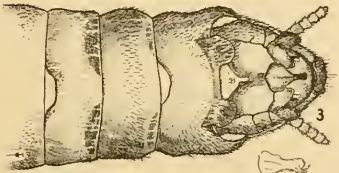
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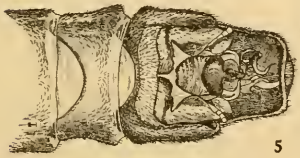
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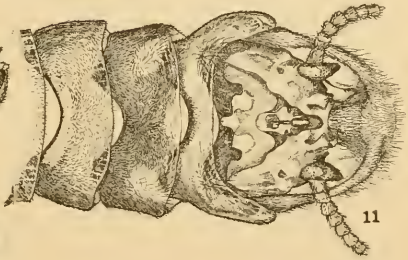
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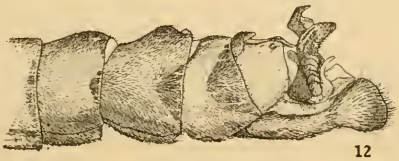
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PLATE 46.

Genitalia of Taeniopteryx.

Fig. 1. *Taeniopteryx occidentalis* Bks. ♀.
Fig. 2. *Taeniopteryx fasciata* Burm. ♀.
Fig. 3. *Taeniopteryx pacifica* Bks. ♀.
Fig. 4. *Taeniopteryx nigripennis* Bks. ♀.
Fig. 5. *Taeniopteryx californica* sp nov. ♀.
Fig. 6. *Taeniopteryx grinnelli* Bks. ♂, side view.
Fig. 7. *Taeniopteryx maura* Pict. ♀.
Fig. 8. *Taeniopteryx nivalis* Fitch. ♀.
Fig. 9. *Taeniopteryx parvula* Bks. ♀.
Fig. 10. *Taeniopteryx banksii*, nom. nov. ♀.
Fig. 11. *Taeniopteryx pallida* Bks. ♀.

PLATE 46.

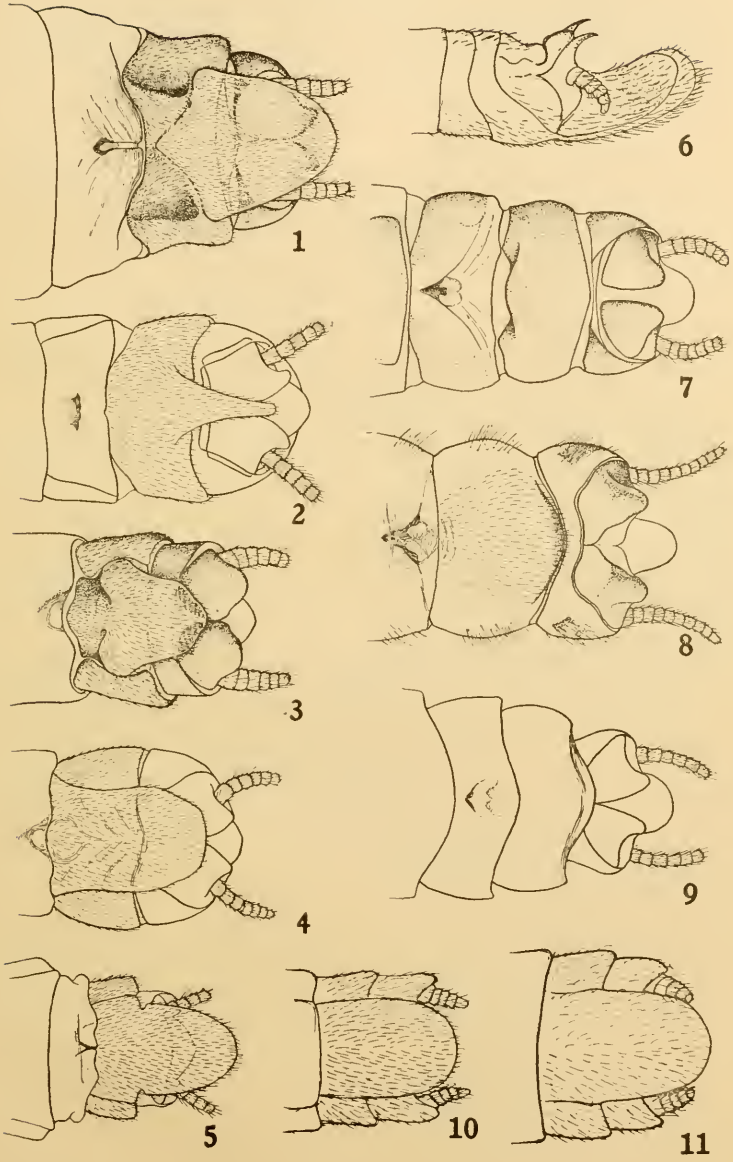


PLATE 47.

Wings of Capniidae.

Fig. 1. *Capnella pygmaea* Burm. ♀.
Fig. 2. *Capnia brevicauda* sp. nov.
Fig. 3. *Capnella granulata* Clsn. ♂.
Fig. 4. *Capnia manitoba* Clsn.
Fig. 5. *Capnella granulata* Clsn. ♀.
Fig. 6. *Capnia vernalis* Burm.
Fig. 7. *Capnura venosa* Bks.
Fig. 8. *Capnella pygmaea* Burm. ♂.

PLATE 47.

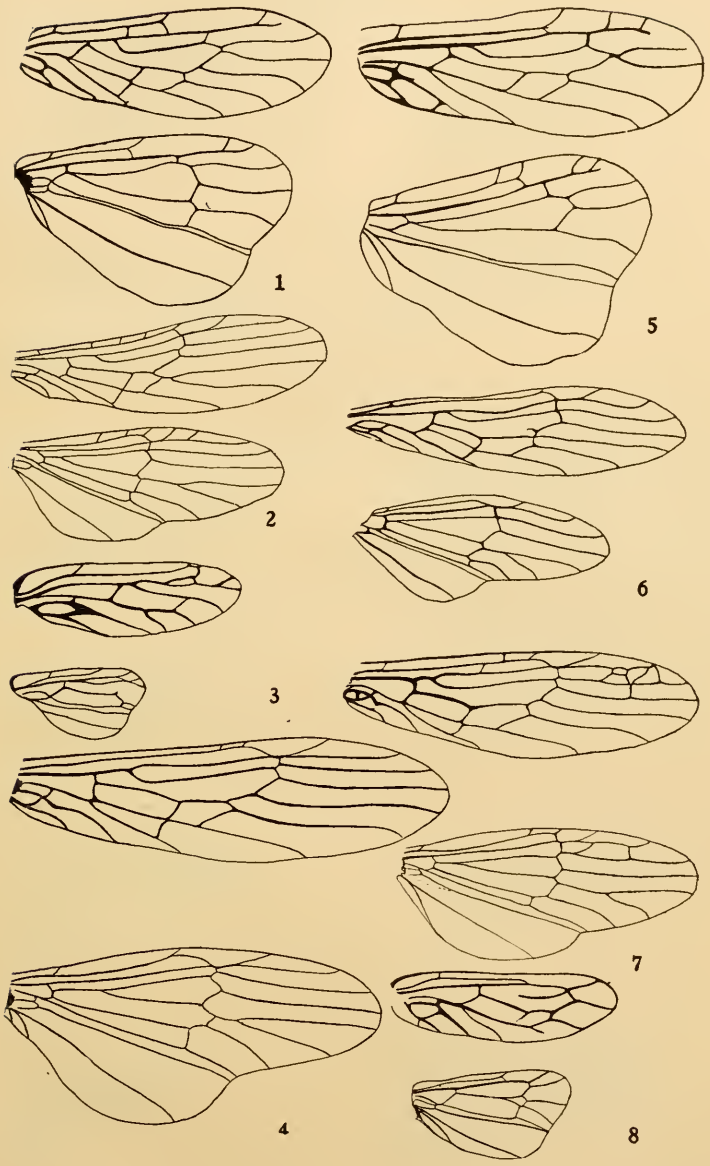
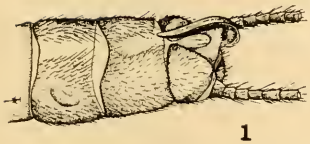


PLATE 48.

Genitalia of Capnia.

Fig. 1. *Capnia vernalis* Newp. ♂.
Fig. 2. *Capnia vernalis* Newp. ♀, ventral view.
Fig. 3. *Capnia nana* Clsn. ♂.
Fig. 4. *Capnia glabra* Clsn. ♂.
Fig. 5. *Capnia gracilaria* Clsn. ♂.
Fig. 6. *Capnia grandis* Bks. ♂.
Fig. 7. *Capnia elongata* Clsn. ♂.
Fig. 8. *Capnia excavata* Clsn. ♂.
Fig. 9. *Capnia tumida* Clsn. ♂.
Fig. 10. *Capnia teresa* Clsn. ♂.
Fig. 11. *Capnia californica* Clsn. ♂.
Fig. 12. *Capnia fibula* Clsn. ♂.

PLATE 48.



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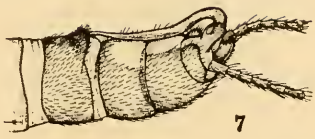

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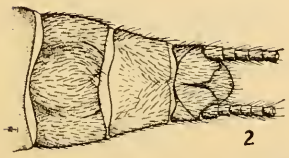

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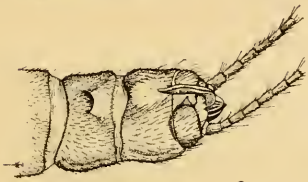

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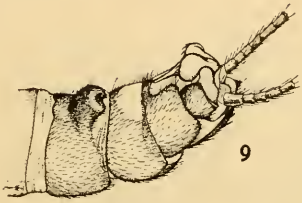

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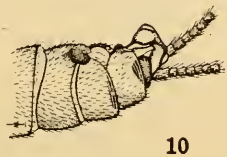

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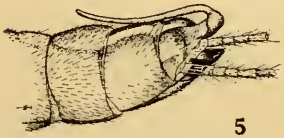

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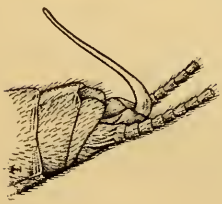

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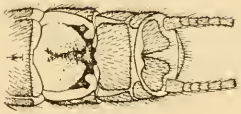
PLATE 49.

Genitalia of Capnia.

Fig. 1. *Capnia fibula* Clsn. ♀, ventral view.
Fig. 2. *Capnia nearctica* Bks. ♂.
Fig. 2a. *Capnia nearctica* Bks. ♂, dorsal view of supra-anal process.
Fig. 3. *Capnia nearctica* Bks. ♀, ventral view.
Fig. 4. *Capnia decepta* Bks. ♂.
Fig. 4a. *Capnia decepta* Bks. ♂, dorsal view of supra-anal process.
Fig. 5. *Capnia decepta* Bks. ♀, ventral view.
Fig. 6. *Capnia columbiana* Clsn. ♂.
Fig. 7. *Capnia columbiana* Clsn. ♀, ventral view.
Fig. 8. *Capnia manitoba* Clsn. ♂.
Fig. 9. *Capnia manitoba* Clsn. ♀, ventral view.
Fig. 10. *Capnia barberi* Clsn. ♂.
Fig. 11. *Capnia bakeri* Bks, ♀, ventral view.
Fig. 12. *Capnia brevicauda* Clsn. ♀, ventral view.
Fig. 13. *Capnura venosa* Bks. ♀, ventral view.

PLATE 49.

1



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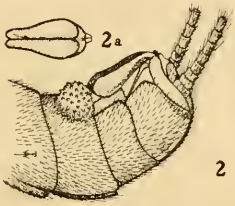

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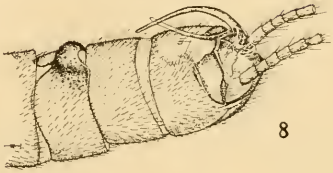

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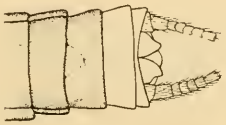

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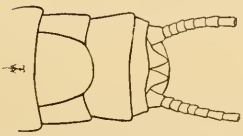

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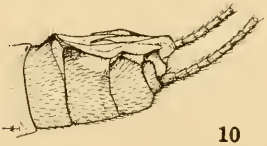

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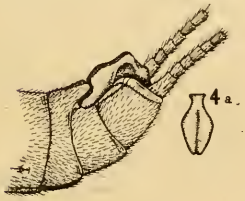

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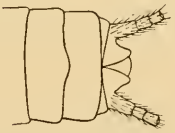

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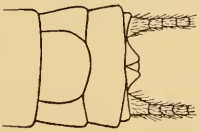

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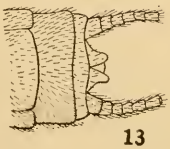

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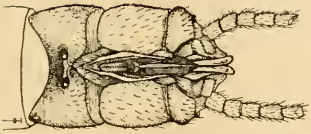
PLATE 50.

Genitalia of Capnella.

Fig. 1. *Capnella pygmaea* Burm. ♂, dorsal view.
Fig. 2. *Capnella pygmaea* Burm. ♂, side view.
Fig. 2a. *Capnella pygmaea* Burm. ♂, tip of supra-anal process.
Fig. 3. *Capnella pygmaea* Burm. ♀, ventral view.
Fig. 4. *Capnella vivipara* Clsn. ♂.
Fig. 5. *Capnella vivipara* Clsn. ♀, ventral view.
Fig. 6. *Capnella granulata* Clsn. ♂.
Fig. 6a. *Capnella granulata* Clsn. ♂, knobs on seventh tergite, dorsal view.
Fig. 7. *Capnella granulata* Clsn. ♀, ventral view.
Fig. 8. *Capnella recta* Clsn ♂.
Fig. 9. *Capnella recta* Clsn. ♀, ventral view.
Fig. 10. *Capnella incisura* Clsn. ♀, ventral view.
Fig. 11. *Capnella incisura* Clsn. ♂, side view.

PLATE 50.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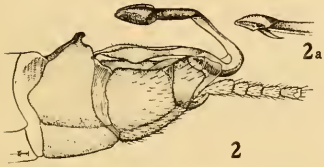
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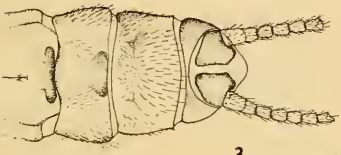
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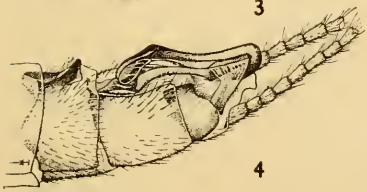
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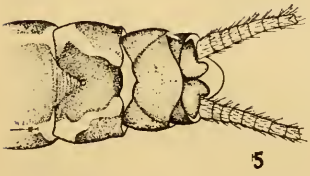
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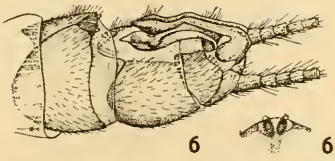
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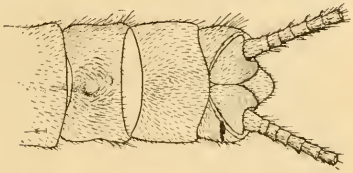
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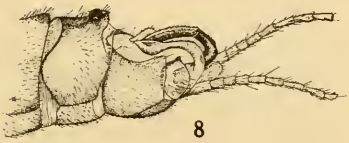
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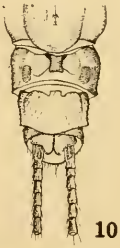
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